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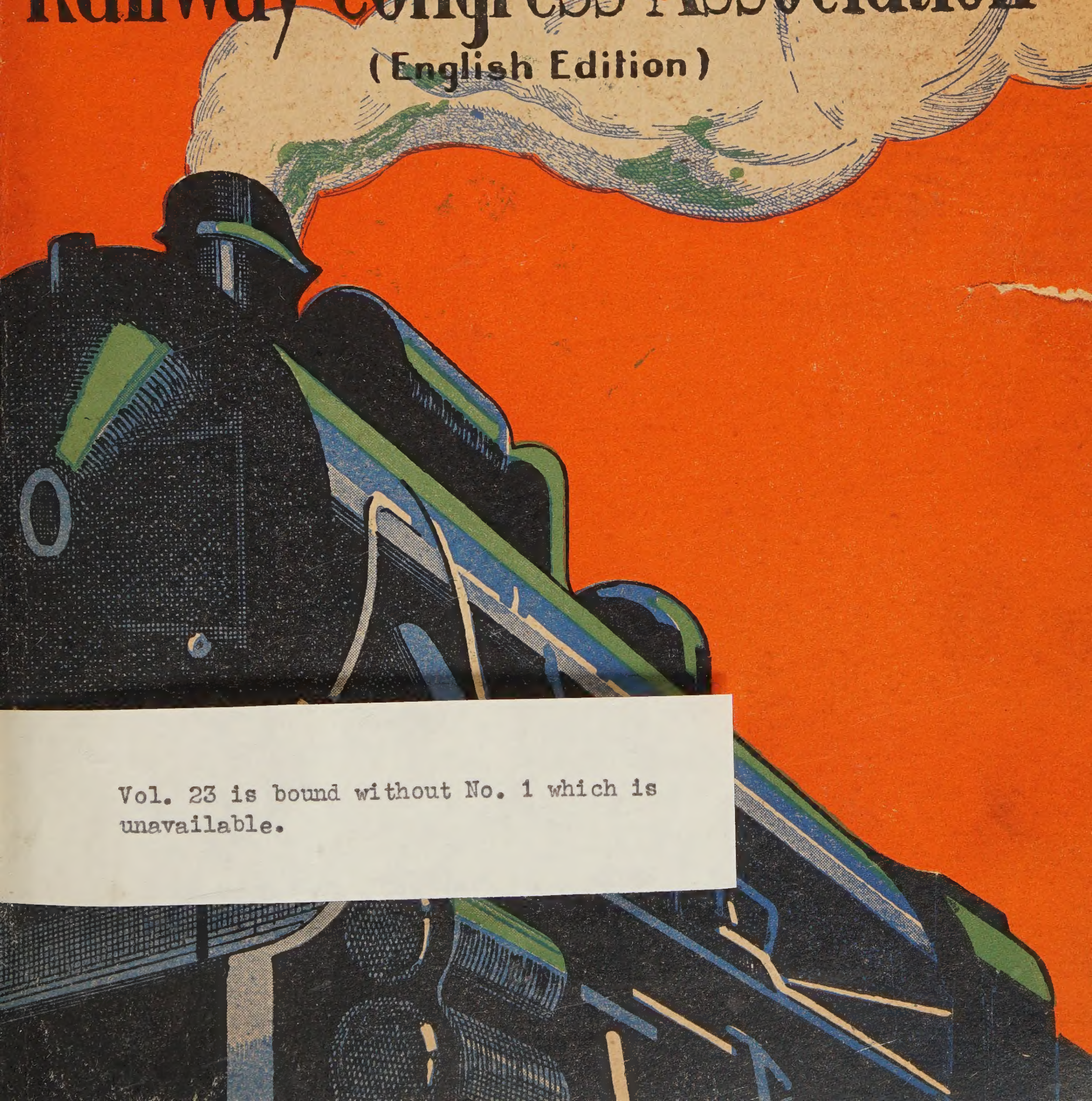
(English Edition)



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ANALYTICAL TABLE OF ARTICLES

ARRANGED ACCORDING TO THE DECIMAL CLASSIFICATION

(1946)

6. Useful Arts.

62. Engineering.

621. Mechanical and electrical engineering.

621 .1. Steam engineering.

621 .13. Locomotive engines.

656. Transport by road, rail, etc.

656. 2. Carriage by railway. Railway working.

CONTENTS

OF THE

23rd YEAR OF THE ENGLISH EDITION.

Alphabetical Index of Advertisers

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OF THE

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CONTENTS OF THE NUMBER FOR MAY 1946.

CONTENTS — Page

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BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[625. 172 (.493)]

Correcting the level and alignment of the track by means of optical instruments,

by Mr. R. CAMPUS,
Honorary Chief Engineer of the Belgian National Railways,
Honorary Professor of the « Faculté polytechnique » of Mons.

The method of correcting the level and alignment of the permanent way with the aid of a telescope and a sighting board has been in use on the Belgian National Railways for some ten years past.

Mr. De Vos, Permanent Way Inspector, conceived the idea of replacing the actual cord, or length of string, hitherto employed in the rectification of curves, by a sight taken optically, employing for this purpose a sighting tube or telescope, and a sighting board, movable with respect to some defined fixed point. It was quite recently and by chance that he

Fig. 1.

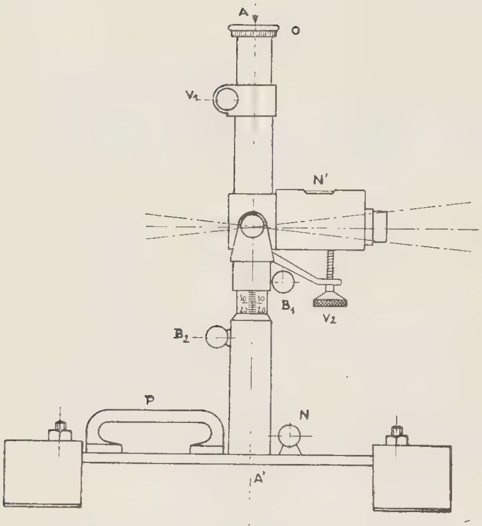


Fig. 2.

happened to find in an English technical publication « The Railway Engineer » (No. 10, October 1934) an article showing that the idea was not new.

* * *

CHAPTER I.

The correction of level and alignment.

§ 1. — The optical instruments used on the Belgian National Railways for correcting alignments are identical with those employed for observing differences of level in the track, calling for rectification by the process of shovel packing (fig. 1).

The sighting tube (fig. 2) consists of an eyepiece in which there is a chamber fitted with cross-wires or hairs, one horizontal, the other vertical. The actual eyepiece 0 is adjustable by rotation to obtain the correct relationship with respect to the cross-wire chamber to suit the eyesight of the individual operator. The adjustment of the telescope itself to suit the particular distance to the sighting board is effected by sliding the complete unit, eyepiece proper and cross-wire chamber, with the aid of a rack actuated by a screw V_1. A transverse level N allows of the two cross-wires being set truly horizontal and vertical. The regulating screw V_2, which allows the hori-

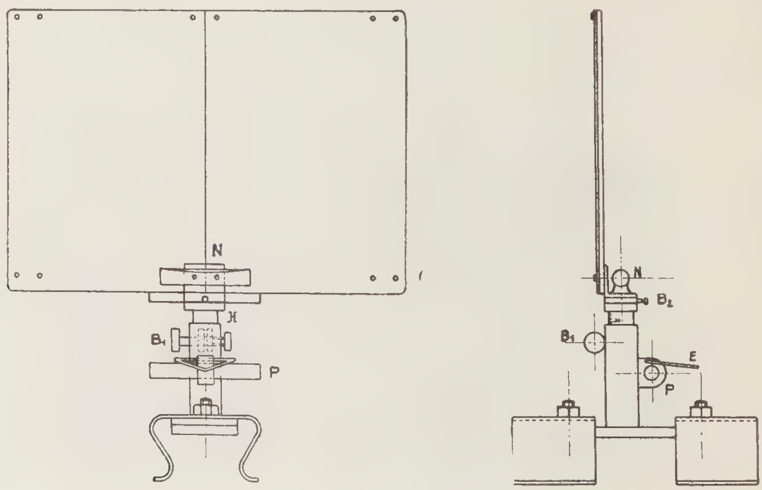


Fig. 3.

zontal cross-wire to be made to coincide exactly with the zero line of the graduation on the sighting board, is only of interest in connection with the levelling of the track.

The telescope device complete is mounted on the rails by means of a straight edge or plate fitted with two spring grippers, which take hold of the head of the rail and are shaped to suit. These grippers are secured to the straight edge by bolts and can thus be detached and replaced with a set of grippers adapted to the various types of rail in use on the railway. The telescope itself can assume various directions around a vertical axis AA′ on unfastening and refastening the setscrew B_1, while another setscrew B_2 controls the vertical adjustment. This latter setscrew only requires to be used when dealing with the measurement of depressions in the track. The handle P serves to place the device in position and remove it from the rails.

In order to enable the sighting board to be used for the correction of alignments, its back is painted blue and marked with a central white vertical line, 2 mm. (5/64 inch.) broad (fig. 3). The board is attached to the rails by grippers similar to those just described. A horizontal level N allows the white mark to be set perfectly vertical. This device also has a handle for readily fixing in position and removal.

§ 2. — The correction of an alignment is effected in a manner pratically perfect and with the greatest ease in the following conditions :

The course of the track being marked out by pegs, or other marks, spaced at intervals of 100 m. (328 ft.) along the alignment, the correct position of two points A and C is obtained with respect to such marks for one of the rails of the track due to be corrected (fig. 4), these points being carefully selected and spaced about 60 m. (196 ft. 10 1/4 in.) apart with the aid of ranging rods.

The operator at the telescope adjusts the eye-piece to suit his sight, so as to get a perfectly clear vision of the cross-wires, and sets the instrument vertically on the rail at the point A, with the aid of the spirit level N. The person carrying the sighting board places that also vertically in position on the rail at C with its blue face towards the telescope. The distance between the two should not exceed 60 m. (196 ft. 10 1/4 in.) so as to ensure a clear view of the white line on the board.

The observer at the telescope adjusts the instrument for sighting the board clearly over the distance AC by shifting the eye-piece and cross-wire unit complete by means of the rack actuated by the screw V_1, and sets the apparatus so as to make the vertical wire line coincide with the white line on the sighting board.

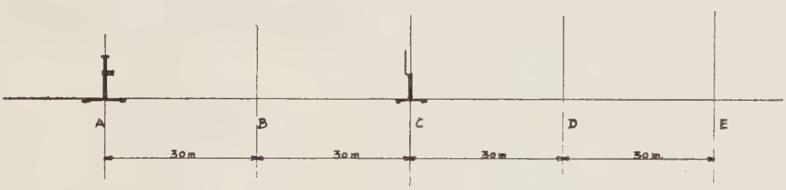


Fig. 4.

Having done so, he secures the telescope firmly in position by the setscrew B_1.

He then puts the sighting board similarly in place at intermediate points between C and B, the latter being spaced approximately half-way between A and C, adjusts the telescope and brings the axis of the white line into coincidence with the vertical cross-wire, by shifting the rail where the sighting board is placed by means of crowbars or other slewing tools.

To correct the second portion of the alignment AC between A and B, the telescope has to be placed in position at C, without altering its set-up, and the sighting board at A. In this way, the bringing of the board and telescope too close together, which would make the adjustment difficult, is avoided, and also in consequence the risk of upsetting the position of the telescope, which might be likely to occur if it were too near to the slewing tools.

The correction of the alignment between A and D, in the direction of the latter, is then continued with the telescope placed in position at point B, with its setting unaltered, approximately half-way between points A and C, the sighting board being located at D, about 60 m. (196 ft. 10 1/4 in.) from B.

The correct position for point D is obtained by slewing the track at the spot until the white line and cross-wire again coincide, as above described. The board is then set in position at intermediate points between D and C, themselves already corrected, in order to rectify such points. The process is then continued by setting up the telescope at C and the board at E, in the manner described, and so on.

* * *

CHAPTER II.

The correction of curves.

§ 1. — To prevent transverse shocks and oscillations, alike unpleasant for passengers and harmful to rolling stock and the curved parts of the permanent way, the following arrangements require to be properly observed :

In the circular portion of the curve the correct radius must be carefully maintained, together with the appropriate superelevation.

Where it begins and ends the circular pathway must be connected to the adjacent portions of straight track by suitable lengths in which the curvature and superelevation increase or decrease progressively. The most usually adopted method of effecting such a transition is one in which both these characteristics increase lineally with the distance.

The increase corresponds to a cubic parabola, the equation of which, with respect to the tangent and the normal of origin is :

$$y = kx^3 \text{ (fig. 5).}$$

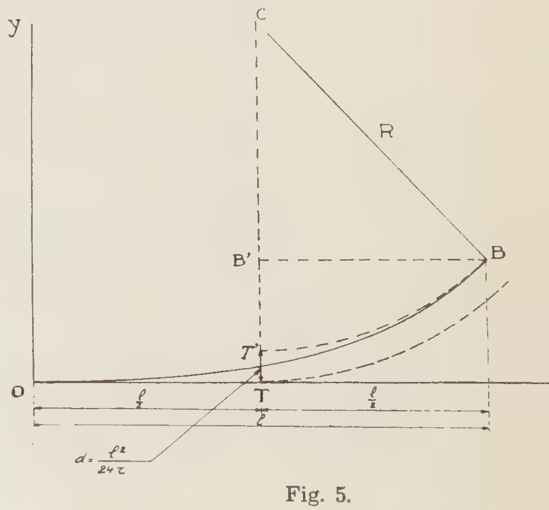


Fig. 5.

The progressive increase in the superelevation of the outer rail with respect to the centre of curvature is obtained by giving to that rail a rise relative to the inner rail of inclination :

$$i = \frac{h}{l},$$

h being the superelevation of the circular curve and l the length of the parabolic transition curve. This must be the less as the speed is the greater in order to avoid giving a sudden jolt to the seating of the vehicles on the track. The gradient of increase in superelevation should never exceed 0.002 and should preferably be as near as possible to 0.001 on high speed lines.

At the Paris Session of the International Railway Congress Association in 1937 it was advocated :

$$i = \frac{1}{10\ V},$$

V being the speed in km. p. h.

The expression giving the radius of curvature is :

$$\rho = \frac{\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}{\frac{d^2y}{dx^2}}.$$

Within the area covered by the arcs of the transition curve $\frac{dy}{dx}$ may be considered so small that its square is negligible in regard to 1. So too the abscissa and the length of the arc may be regarded as being identical and the radius of curvature to be given by the expression simplified :

$$\rho = \frac{1}{\frac{d^2y}{dx^2}} = \frac{1}{6\ kx}.$$

The value k is determined by the condition that when $x = l$, $\rho = R$, radius of the circular arc.

Then

$$R = \frac{1}{6\ kl}$$

and $k = \frac{1}{6\ l R}$.

The equation for the cubic parabola connecting a straight line and a circle of radius R by an arc of length l is therefore :

$$y = \frac{x^3}{6\ l R}.$$

For $x = l$,

$$y_B = \frac{l^2}{6\ R}.$$

The abscissa of the centre of curvature is :

$$\xi = x - \rho \frac{dy}{dx} = x - \frac{x}{2} = \frac{x}{2},$$

or half the abscissa of the corresponding of the curve.

In consequence :

$$x_C = O\ T = \frac{l}{2}$$

$$y_C = R + T\,T' = R + y_B - B'\,T'$$

$$= R + \frac{l^2}{6R} - \frac{l^2}{8R} = R + \frac{l^2}{24R}.$$

The lay-out is therefore simple. The centre of the circular arc is displaced by $\frac{l^2}{24R}$ perpendicularly to the alignment. The transition curves between the alignment and the circular arc come at a distance of $\frac{l}{2}$ on either side of the normal of the alignment, passing through the centre of the circular arc.

Progressive transitions are also made

between circular curves of different radius and like concavity (fig. 6).

From the point of origin O of the transition curve on the tangent com-

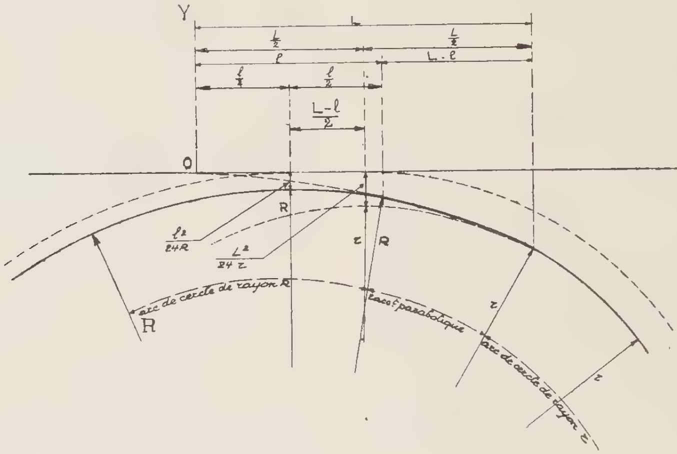


Fig. 6.

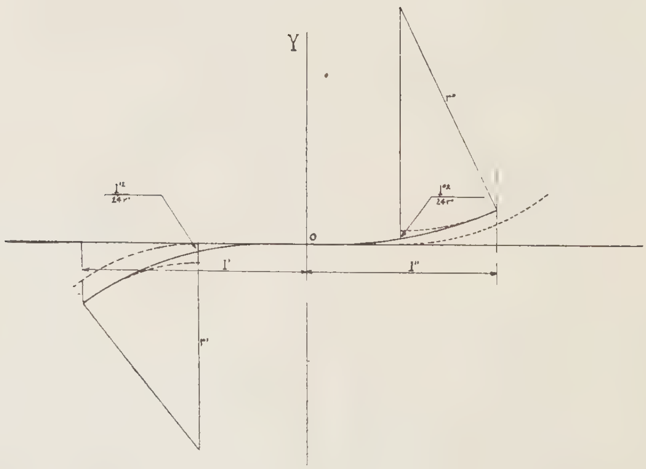


Fig. 7.

mon to the two original circular arcs, the length of the parabolic transition to the circular arc of radius r is L and the length of that to the circle R is $l <$ L.

On the other hand, the transition curve is unique and can but have one equation. Thus :

$$y = \frac{x^3}{6\,l\,R} = \frac{x^3}{6\,L\,r}$$

from which we get

$$\frac{L}{l} = \frac{R}{r}.$$

The length of transition between the two curves is equal to L = l.

Finally, two circular and opposite curves can likewise be connected by two parabolas of the third degree. These, the curvature of which is of opposite sign, are often separated by a length of straight track, but when this is not to be of appreciable length, it is preferable to do without it. The two parabolas are then adjacent and change direction at their zero point of curvature, which becomes the point where the pathway of the track changes (fig. 7); the superelevation varies uninterruptedly throughout the length of the transition between the two circular curves, the vehicles thus performing a continuous rotation in a longitudinal sense, giving rise to no shock or other unpleasant reaction, even at very high speeds, if both the layout of the track and superelevation are quite satisfactory.

§ 2. — The rectification of the line of curved tracks marked out by pegs or other objects cannot be satisfactorily effected merely by adjusting the track with respect to them, because :

— such objects themselves get out of place in the course of time for various reasons, especially the settlement of the ground ;

— the spacing of the pegs [20 m. (65 ft. 7 3:8 in.) in circular curves and 10 m. (32 ft. 9 3/4 in.) in parabolic transitions] is too great to permit of rectification being perfectly effected, even though the pegs are accurately in position.

To achieve practically perfect results in these cases it is essential to proceed in the first place to an approximate correction, as exact as possible with respect to the pegs, of the straight lengths, parabolic transitions and circular curves; and then proceed to rectify the curve, starting at the ends of the straight alignments, themselves corrected as already explained, and working towards the middle.

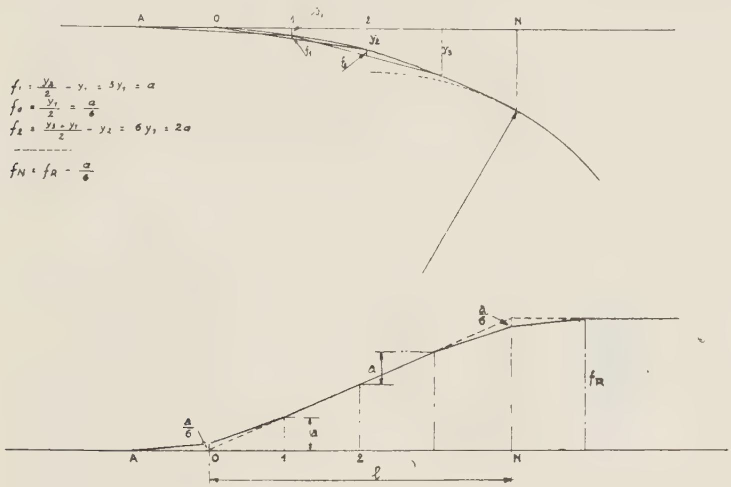


Fig. 8.

§ 3. — *Correction of curves by stringlining.*

Hitherto curves have been corrected for position by means of a cord, or stringlining as it is termed.

Fig. 8 gives a diagram of the versines of a parabolic transition curve connecting straight track with a circular curve.

In the latter portion the versines measured at the centre of a cord or string of given length are all equal. The versines of the parabolic curve increase on a linear law. The versine at O where the straight path and the transition meet (with the cord set across between the two) is equal to $\frac{a}{6}$. The versine at the point where the parabola and circular curve meet (similarly measured) is equal to $f_R - \frac{a}{6}$.

It is customary to use a 20 m. (65 ft. 7 3/8 in.) cord and to measure the versines at 10 m. (32 ft. 9 3/4 in.) distances, as shown in fig. 9.

This process is extremely susceptible to error and possesses several disadvantages.

It is very difficult to keep the cord sufficiently taut, and avoid its sagging under its own weight, while maintaining its ends is proper contact with the rail. If, for example, the cord is held against it at the point A (fig. 10), and the versine is taken off at point B (fig. 11) by reason of the cord sagging an appreciable error of measurement will result, on account of the 1/20 cant given to the rail.

Fig. 9.

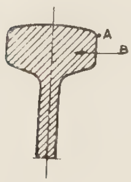


Fig. 10.

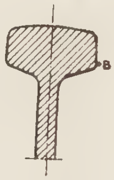


Fig. 11.

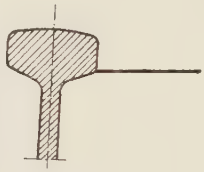


Fig. 12.

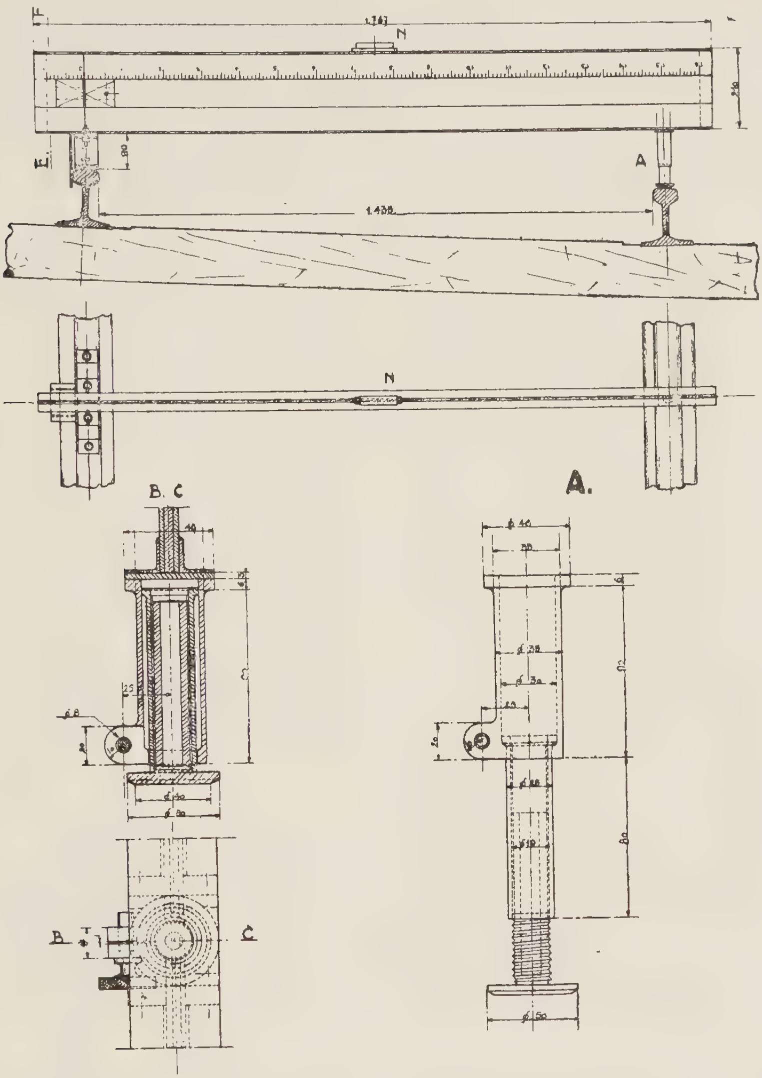
Side-wear on the rail-head can equally give rise to mistakes.

These two sources of error can, however, be got rid of by applying the cord at point B (fig. 12) and supporting the middle of it on the scale used to measure the versine.

Care has to be taken to make sure that the cord has not got caught up and to shake it by raising it gently so as to get rid of an effect of friction, before reading of the versine.

It is nonetheless correct to remark that these sensible recommendations can be neglected by those concerned.

PLATE 1.



Front elevation.

Plan view.

Section B. C.

Apparatus in extended condition.

Plan view.

If a wire cord is used, it has a tendency to stretch, and if a steel wire (piano wire) is employed, it is liable to become entangled and to break in consequence.

The use of string-lining too causes much loss of time, the men who have to correct the track having to move to and fro repeatedly, to allow of further rectifications being made and to place the cord in position again after each act of slewing until the versine measured is the one wanted. Another source of loss of time is the taking of the cord from

place ta place at 10 m. (32 ft. 9 3/4 in.) intervals.

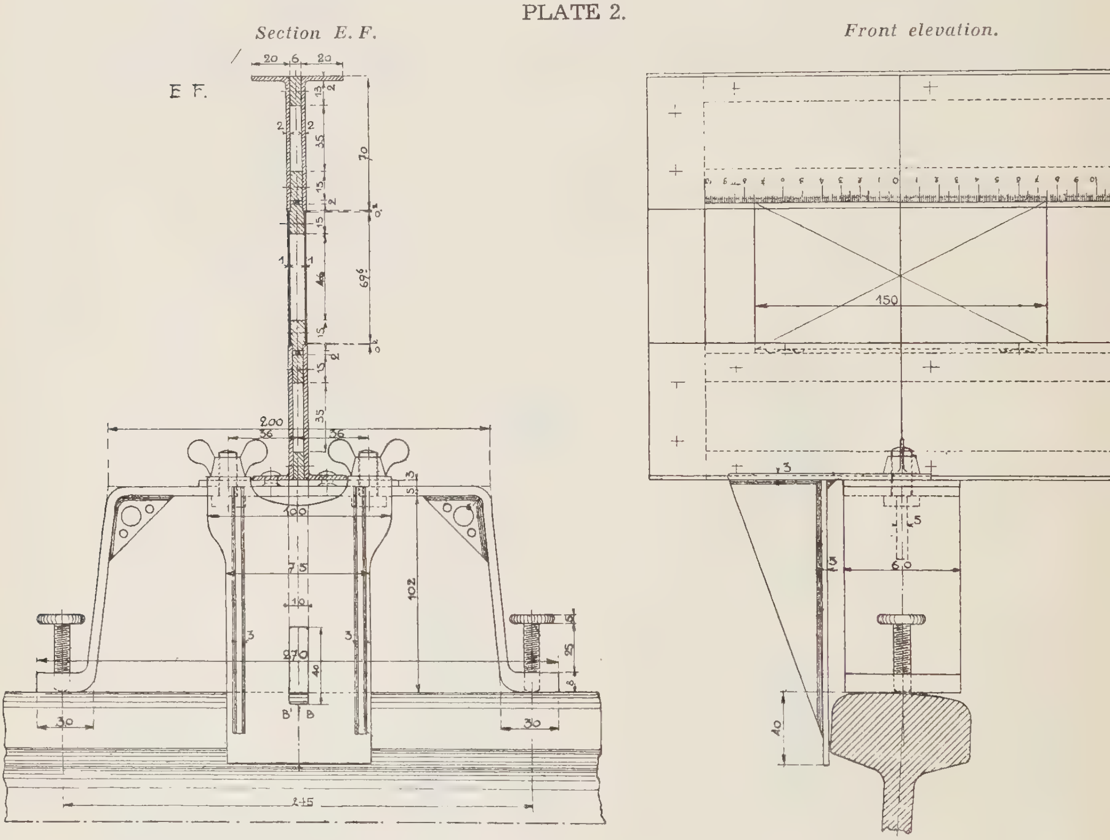
§ 4. — *Correction of curves with the optical sight.*

These sources of error and inconvenience can be eliminated by substituting an optical « cord » or line of sight, for the material one measuring 20 m. (65 ft. 7 3/8 in.), with the aid of the telescope used for the process of levelling the track and a sliding sight board.

The last named (plates 1 & 2) has two actual board or targets; one, fixed and painted blue, and another painted red, both provided with a vertical white line.

When the equipment is in place on the track, the white line on the fixed blue board coincides with the axis of the superelevated rail, corresponding to the zero mark on the graduated scale. The red board can be adjusted in position with respect to the fixed blue one, being arranged to slide in a frame. It is provided with light friction springs, offering a slight resistance to any movement of the board and allowing the white line on the board to be brought into exact agreement with any desired mark on the graduated scale from 0 mm.

PLATE 2.



(when both white marks are in coincidence to 1 500 mm. (4 ft. 11 in.) (versine of a circular arc of 300 m. (984 ft. 3 in.) radius, subtended by a 60 m. (196 ft. 10 1/4 in.) chord).

The board has a fixed stop on the side referring to the superelevated rail; when the stop is applied to the lateral outer face of this rail, the white line of the fixed blue board coincides with its axis.

The support for the board on the inner rail of the curve is provided with a screw enabling the horizontal setting of the board to be correctly obtained, and in consequence, the vertical setting of the white lines on the two boards, a spirit level being provided to read by.

The support on the rail alongside the blue board is fitted with two adjusting screws to enable the vertical position of the white lines to be obtained, when the track has no superelevation on curves of large radius.

As the board is supported against the outer edge of the rail to be corrected, the source of error which could arise from side wear when using a cord, is eliminated.

With the aid of the telescope it is possible to work with chords of over 20 m. (65 ft. 7 3/8 in.). The experience so far gained shows that a distance of 60 m. (196 ft. 10 1/4 in.) suits very well. With that the versines are read off at 30 m. (98 ft. 5 1/8 in.) intervals.

* * *

How the device is used (Plate 3).

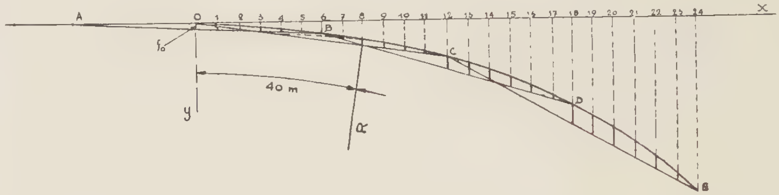
To effect the rectification of a portion of curved track the telescope is first placed in position on the rail at point A, on an already corrected alignment, 30 m. (98 ft. 5 1/8 in.) from the beginning at O of the parabolic transition, where the board capable of sliding adjustment is likewise set in position. The red screen of this board is set opposite to the mark on the graduated scale which represents the value of the versine f_0 corresponding to the chord AB, across both the straight track and the parabola, after which the telescope is directed so as to bring the vertical cross-wire into agreement with the white mark on the board. The telescope is then secured in this position by the setscrew B_2 (fig. 2). The sliding board is then placed at B and the white mark is brought to agree with zero on the graduated scale. If the permanent way at B is not in its proper place, that is to say if the vertical cross-wire does not coincide with the white mark on the red screen, the track is slewed until this has been effected. The sliding board is then moved a distance of 5 m. (16 ft. 5 in.) towards the telescope and the white mark on the red screen is brought to agree with the graduation corresponding to the ordinate y_5 of the curve OB with respect to the chord AB. The track is then shifted in the neighbourhood of the board until the vertical cross-wire again agrees with the mark on the red screen. The track has now been duly corrected at this spot. The sliding board is once more moved 5 m. (16 ft. 5 in.) towards the telescope and the same process continued every 5 m. (16 ft. 5 in.) up to the point O; when this has been done the curve OB will have been corrected.

The telescope is then moved to O and the board to B. The white mark on the red screen is then brought into agreement with the graduation mark corresponding to the value of the versine f_B refering to the chord OC. The telescope is then set to bring the vertical cross-wire to agree with the white mark

PLATE 3.

CORRECTION OF CURVES BY MEANS OF TELESCOPE AND SIGHTING BOARD.

EQUATION OF PARABOLIC TRANSITION 40 m. (131 ft. 2 3/4 in.) LONG : $y = \frac{x^3}{6\,L\,R} = \frac{x^3}{240\,R}$.
LENGTH OF THE CHORD : 60 m. (196 ft. 10 1/4 in.).



Ordinates of the arc AOB	Ordinates of the chord AB	Ordinates of the arc AOB with respect to the chord AB
$y_0 = 0$ $y_1 = \frac{5^3}{240R} = \frac{125}{240R}$ $y_2 = \frac{10^3}{240R} = \frac{1000}{240R}$ $y_3 = \frac{15^3}{240R} = \frac{3375}{240R}$ $y_4 = \frac{20^3}{240R} = \frac{8000}{240R}$ $y_5 = \frac{25^3}{240R} = \frac{15625}{240R}$ $y_6 = \frac{30^3}{240R} = \frac{27000}{240R}$	$y_0 = \frac{1}{2} y_6 = \frac{13500}{240R}$ $y_1 = \frac{7}{12} y_6 = \frac{15750}{240R}$ $y_2 = \frac{8}{12} y_6 = \frac{18000}{240R}$. $y_3 = \frac{9}{12} y_6 = \frac{20250}{240R}$. $y_4 = \frac{10}{12} y_6 = \frac{22500}{240R}$. $y_5 = \frac{11}{12} y_6 = \frac{24750}{240R}$. $y_6 = \frac{27000}{240R}$	$f_0 = \frac{13500}{240R}$ $y_1 = \frac{15625}{240R}$ $y_2 = \frac{17000}{240R}$ $y_3 = \frac{16875}{240R}$ $y_4 = \frac{14500}{240R}$ $y_5 = \frac{9125}{240R}$ $y_6 = 0$
Ordinates of the arc OBC	**Ordinates of the chord OC**	**Ordinates of the arc OBC with respect to the chord OC**
$y_B = \frac{30^3}{240R} = \frac{27000}{240R}$ $y_7 = \frac{35^3}{240R} = \frac{42875}{240R}$ $y_8 = \frac{40^3}{240R} = \frac{64000}{240R}$. $y_9 = \frac{64000}{240R} + \frac{25^2-20^2}{2R} = \frac{91000}{240R}$. $y_{10} = \frac{91000}{240R} + \frac{30^2-25^2}{2R} = \frac{124000}{240R}$. $y_{11} = \frac{124000}{240R} + \frac{35^2-30^2}{2R} = \frac{163000}{240R}$. $y_{12} = \frac{163000}{240R} + \frac{40^2-35^2}{2R} = \frac{208000}{240R}$.	$y_B = \frac{1}{2} y_{12} = \frac{104000}{240R}$ $y_7 = \frac{7}{12} y_{12} = \frac{121333}{240R}$ $y_8 = \frac{8}{12} y_{12} = \frac{138667}{240R}$ $y_9 = \frac{9}{12} y_{12} = \frac{156000}{240R}$ $y_{10} = \frac{10}{12} y_{12} = \frac{173333}{240R}$ $y_{11} = \frac{11}{12} y_{12} = \frac{190667}{240R}$ $y_{12} = \frac{208000}{240R}$	$f_B = \frac{77000}{240R}$ $y_7 = \frac{78458}{240R}$ $y_8 = \frac{74667}{240R}$ $y_9 = \frac{65000}{240R}$ $y_{10} = \frac{49333}{240R}$ $y_{11} = \frac{27667}{240R}$ $y_{12} = 0$
Ordinates of the arc BCD	**Ordinates of the chord BD**	**Ordinates of the arc BCD with respect to the chord BD**
$y_C = y_{12} = \frac{208000}{240R}$. $y_{13} = \frac{208000}{240R} + \frac{45^2-40^2}{2R} = \frac{259000}{240R}$. $y_{14} = \frac{259000}{240R} + \frac{50^2-45^2}{2R} = \frac{316000}{240R}$. $y_{15} = \frac{316000}{240R} + \frac{55^2-50^2}{2R} = \frac{379000}{240R}$ $y_{16} = \frac{379000}{240R} + \frac{60^2-55^2}{2R} = \frac{448000}{240R}$. $y_{17} = \frac{448000}{240R} + \frac{65^2-60^2}{2R} = \frac{523000}{240R}$. $y_{18} = \frac{523000}{240R} + \frac{70^2-65^2}{2R} = \frac{604000}{240R}$.	$y_C = \frac{1}{2}(y_6 + y_{18}) = \frac{315500}{240R}$ $y_{13} = y_6 + \frac{7}{12}(y_{18} - y_6) = \frac{363583}{240R}$ $y_{14} = y_6 + \frac{8}{12}(y_{18} - y_6) = \frac{411667}{240R}$ $y_{15} = y_6 + \frac{9}{12}(y_{18} - y_6) = \frac{459750}{240R}$ $y_{16} = y_6 + \frac{10}{12}(y_{18} - y_6) = \frac{507833}{240R}$ $y_{17} = y_6 + \frac{11}{12}(y_{18} - y_6) = \frac{555917}{240R}$ $y_{18} = \frac{604000}{240R}$	$f_C = \frac{107500}{240R}$ $y_{13} = \frac{104583}{240R}$. $y_{14} = \frac{95667}{240R}$ $y_{15} = \frac{80750}{240R}$. $y_{16} = \frac{59833}{240R}$. $y_{17} = \frac{32917}{240R}$. $y_{18} = 0$
Ordinates of the arc CDE	**Ordinates of the chord CE**	**Ordinates of the arc CDE with respect to the chord CE**
$y_D = y_{18} = \frac{604000}{240R}$ $y_{19} = y_{12} + \frac{75^2-70^2}{2R} = \frac{691000}{240R}$. $y_{20} = y_{12} + \frac{80^2-70^2}{2R} = \frac{784000}{240R}$. $y_{21} = y_{12} + \frac{85^2-70^2}{2R} = \frac{883000}{240R}$. $y_{22} = y_{12} + \frac{90^2-70^2}{2R} = \frac{988000}{240R}$. $y_{23} = y_{12} + \frac{95^2-70^2}{2R} = \frac{1099000}{240R}$. $y_{24} = y_{12} + \frac{100^2-70^2}{2R} = \frac{1216000}{240R}$.	$y_D = \frac{1}{2}(y_{12} + y_{24}) = \frac{712000}{240R}$ $y_{19} = y_{12} + \frac{7}{12}(y_{24} - y_{12}) = \frac{796000}{240R}$. $y_{20} = y_{12} + \frac{8}{12}(y_{24} - y_{12}) = \frac{880000}{240R}$. $y_{21} = y_{12} + \frac{9}{12}(y_{24} - y_{12}) = \frac{964000}{240R}$. $y_{22} = y_{12} + \frac{10}{12}(y_{24} - y_{12}) = \frac{1048000}{240R}$ $y_{23} = y_{12} + \frac{11}{12}(y_{24} - y_{12}) = \frac{1132000}{240R}$. $y_{24} = \frac{1216000}{240R}$	$f_D = \frac{108000}{240R} = \frac{3600}{8R}$ $y_{19} = \frac{105000}{240R} = \frac{3500}{8R}$ $y_{20} = \frac{96000}{240R} = \frac{3200}{8R}$ $y_{21} = \frac{81000}{240R} = \frac{2700}{8R}$ $y_{22} = -\frac{60000}{240R} = \frac{2000}{8R}$ $y_{23} = \frac{33000}{240R} = \frac{1100}{8R}$ $y_{24} = 0$

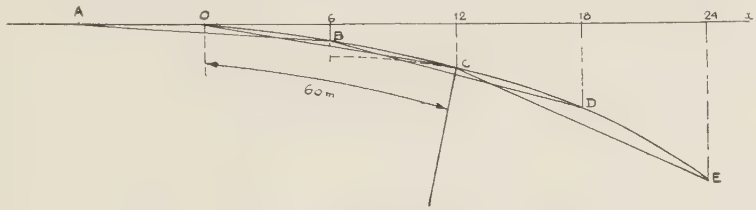
on the red screen, and once more locked in position by means of the setscrew B_1.

The sliding board is then placed at C and the white mark of the red screen brought to agree with zero on the graduated scale. If the track at C is not as it should be, that is if the vertical cross-wire is not in agreement with the white mark of the red screen the track is slewed at that spot until this has been effected. The sliding board is then moved 5 m. (16 ft. 5 in.) towards the telescope and the white mark of the red screen made to agree with the graduation corresponding to the ordinate y_{11} of the curve OBC with respect to the chord OC. The track is then slewed in the neighbourhood of the board as described above, and this corrects the track. The board is again moved 5 m. (16 ft. 5 in.) towards the telescope and the process repeated in the manner already set forth, for 5 m. (16 ft. 5 in.) distance until the length BC is rectified.

PLATE 4.

CORRECTION OF CURVES BY MEANS OF TELESCOPE AND SIGHTING BOARD.

EQUATION OF PARABOLIC TRANSITION 60 m. (196 ft. 10 1/4 in.) LONG : $y = \frac{x^3}{6 L R} = \frac{x^3}{360 R}$.
LENGTH OF THE CHORD : 60 m. (196 ft. 10 1/4 in.).



ORDINATES			
Chord AB	Chord OC	Chord BD	Chord CE
$f_0 = \frac{13500}{360R}$	$f_B = \frac{81000}{360R}$	$f_C = \frac{148500}{360R}$	$f_D = \frac{162000}{360R} = \frac{3600}{8R}$
$y_1 = \frac{15625}{360R}$	$y_7 = \frac{85125}{360R}$	$y_{13} = \frac{146250}{360R}$	$y_{19} = \frac{157500}{360R} = \frac{3500}{8R}$
$y_2 = \frac{17000}{360R}$	$y_8 = \frac{80000}{360R}$	$y_{14} = \frac{135000}{360R}$	$y_{20} = \frac{144400}{360R} = \frac{3200}{8R}$
$y_3 = \frac{16875}{360R}$	$y_9 = \frac{70875}{360R}$	$y_{15} = \frac{114750}{360R}$	$y_{21} = \frac{121500}{360R} = \frac{2700}{8R}$
$y_4 = \frac{14500}{360R}$	$y_{10} = \frac{55000}{360R}$	$y_{16} = \frac{85500}{360R}$	$y_{22} = \frac{90000}{360R} = \frac{2000}{8R}$
$y_5 = \frac{9125}{360R}$	$y_{11} = \frac{31625}{360R}$	$y_{17} = \frac{47250}{360R}$	$y_{23} = \frac{49500}{360R} = \frac{1100}{8R}$
$y_6 = 0$	$y_{12} = 0$	$y_{18} = 0$	$y_{24} = 0$

The process is continued between C and D with respect to the chord BD, as described, until the middle of the curve is reached.

A similar course is pursued starting from the beginning of the transition curve, at the other end of the curve. In that case the other face of the board is made use of, identical with the first, and similarly graduated.

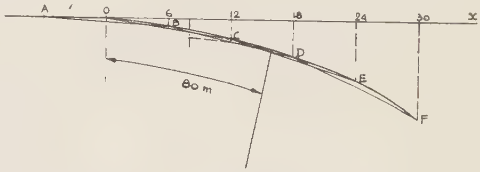
It should be stressed that the telescope has to be set at a fair distance from the points on the permanent way calling for rectification, otherwise it might get slightly out of place when the rails are being pulled over, which will upset the line of sight.

calculated with respect to a chord at 5 m. (16 ft. 5 in.) distances. Plate No. 3 covers the calculations for the ordinates of a parabola 40 m. (131 ft. 2 3/4 in.) long, connecting straight track with a circular curve of radius R. These ordinates are worked out for visual chords

PLATE 5.

CORRECTION OF CURVES BY MEANS OF TELESCOPE AND SIGHTING BOARD.

EQUATION OF PARABOLIC TRANSITION 80 m. (262 ft. 5 3/4 in.) LONG : $y = \frac{x^3}{6\,L\,R} = \frac{x^3}{480\,R}$.
LENGTH OF THE CHORD : 60 m. (196 ft. 10 1/4 in.).



ORDINATES				
Chord AB	Chord OC	Chord BD	Chord CE	Chord DF
$f_O = \frac{13500}{480R}$	$f_B = \frac{81000}{480R}$	$f_C = \frac{161500}{480R}$	$f_D = \frac{212000}{480R}$	$f_E = \frac{216000}{480R} = \frac{3600}{8R}$
$y_1 = \frac{15625}{480R}$	$y_7 = \frac{83125}{480R}$	$y_{13} = \frac{161292}{480R}$	$y_{19} = \frac{206667}{480R}$	$y_{25} = \frac{210000}{480R} = \frac{3500}{8R}$
$y_2 = \frac{17000}{480R}$	$y_8 = \frac{80000}{480R}$	$y_{14} = \frac{151333}{480R}$	$y_{20} = \frac{189333}{480R}$	$y_{26} = \frac{192000}{480R} = \frac{3200}{8R}$
$y_3 = \frac{16875}{480R}$	$y_9 = \frac{70875}{480R}$	$y_{15} = \frac{130875}{480R}$	$y_{21} = \frac{160000}{480R}$	$y_{27} = \frac{162000}{480R} = \frac{2700}{8R}$
$y_4 = \frac{14500}{480R}$	$y_{10} = \frac{55000}{480R}$	$y_{16} = \frac{99167}{480R}$	$y_{22} = \frac{118667}{480R}$	$y_{28} = \frac{120000}{480R} = \frac{2000}{8R}$
$y_5 = \frac{9125}{480R}$	$y_{11} = \frac{31625}{480R}$	$y_{17} = \frac{55583}{480R}$	$y_{23} = \frac{65333}{480R}$	$y_{29} = \frac{66000}{480R} = \frac{1100}{8R}$
$y_6 = 0$	$y_{12} = 0$	$y_{18} = 0$	$y_{24} = 0$	$y_{30} = 0$

In proceeding in the manner described above, the distance between the telescope and the adjustable board is never less than 30 m. (98 ft. 5 1/8 in.).

§ 5. — *Tables facilitating the making of calculations required to effect the correction of curves.*

When correcting a piece of track, the intermediate ordinates of the curve are 60 m. (196 ft. 10 1/4 in.) long, taken across the straight track and the parabola, and again every 30 m. (98 ft. 5 1/8 in.) over the latter and the circular curve.

The versines f_O, f_B, f_C and f_D and the ordinates y_1, y_2, y_3 and so on... are calculated as a function of the radius of the circular curve. They are set out as ordinary fractions, each having the same denominator, in the third column

of the table. In this way the numerical value of all the ordinates covering a section of track to be corrected can be read off easily with the aid of a slide rule, the radius of the circular curve being known.

Plates Nos. 4 to 11 refer to the characteristics of parabolic transitions of 60, 80, 100, 120, 140, 160, 180 and 200 m. (196 ft. 10 1/4 in., 262 ft. 5 3/4 in., 328 ft. 1 in., 393 ft. 8 3/8 in., 459 ft. 3 3/4 in., 524 ft. 11 1/4 in., 590 ft. 6 3/4 in. and 656 ft. 2 in.) connecting straight track with a circular curve of radius R. Plate no. 12 gives an example of the calculation of versines and ordinates, at 5 m. (16 ft. 5 in.) distances, relating to visual chords 60 m. (196 ft. 10 1/4 in.) long, covering a parabolic transition curve connecting two curves of different radius.

§ 6. — *The mid region between corrected curves.*

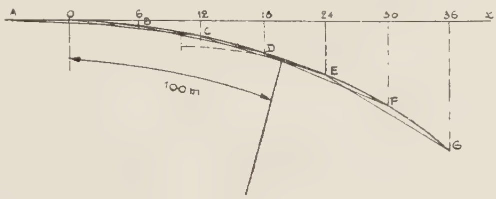
The correction of a curved piece of track, whether effected by starting simultaneously or successively from the ends and working towards the middle, does not, as a rule, allow of the versines contemplated for the mid-way region being strictly obtained.

Let us suppose (Plate 13) the portions AB and DC to have been corrected in the manner described.

PLATE 6.

CORRECTION OF CURVES BY MEANS OF TELESCOPE AND SIGHTING BOARD.

EQUATION OF PARABOLIC TRANSITION 100 m. (328 ft. 1 in.) LONG : $y = \frac{x^3}{6\,L\,R} = \frac{x^3}{600\,R}$.
LENGTH OF THE CHORD : 60 m. (196 ft. 10 1/4 in.).



ORDINATES					
Chord AB	Chord OC	Chord BD	Chord CE	Chord DF	Chord EG
$f_O = \frac{13500}{600R}$	$f_B = \frac{81000}{600R}$	$f_C = \frac{162000}{600R}$	$f_D = \frac{239000}{600R}$	$f_E = \frac{269500}{600R}$	$f_F = \frac{270000}{600R} = \frac{3600}{8R}$
$y_1 = \frac{15625}{600R}$	$y_7 = \frac{83125}{600R}$	$y_{13} = \frac{161875}{600R}$	$y_{19} = \frac{235958}{600R}$	$y_{25} = \frac{262083}{600R}$	$y_{31} = \frac{262500}{600R} = \frac{3500}{8R}$
$y_2 = \frac{17000}{600R}$	$y_8 = \frac{80000}{600R}$	$y_{14} = \frac{152000}{600R}$	$y_{20} = \frac{218667}{600R}$	$y_{26} = \frac{239667}{600R}$	$y_{32} = \frac{240000}{600R} = \frac{3200}{8R}$
$y_3 = \frac{16875}{600R}$	$y_9 = \frac{70875}{600R}$	$y_{15} = \frac{131625}{600R}$	$y_{21} = \frac{186500}{600R}$	$y_{27} = \frac{202250}{600R}$	$y_{33} = \frac{202500}{600R} = \frac{2700}{8R}$
$y_4 = \frac{14500}{600R}$	$y_{10} = \frac{55000}{600R}$	$y_{16} = \frac{100000}{600R}$	$y_{22} = \frac{139333}{600R}$	$y_{28} = \frac{149833}{600R}$	$y_{34} = \frac{150000}{600R} = \frac{2000}{8R}$
$y_5 = \frac{9125}{600R}$	$y_{11} = \frac{31625}{600R}$	$y_{17} = \frac{56375}{600R}$	$y_{23} = \frac{77167}{600R}$	$y_{29} = \frac{82417}{600R}$	$y_{35} = \frac{82500}{600R} = \frac{1100}{8R}$
$y_6 = 0$	$y_{12} = 0$	$y_{18} = 0$	$y_{24} = 0$	$y_{30} = 0$	$y_{36} = 0$

The length of the portion BC remaining to be dealt with is equal to $(60 + x)$ metres, x being less than 30.

The first step is to rectify the portion CC′, the length of which is x metres, in the manner described, by setting the telescope at C″, 60 m. (196 ft. 10 1/4 in.) from C′, and the sliding board at F′, 30 m. (98 ft. 5 1/8 in.) from C′.

The portion BHC′, 60 m. (196 ft. 10 1/4 in.) long remains to be corrected.

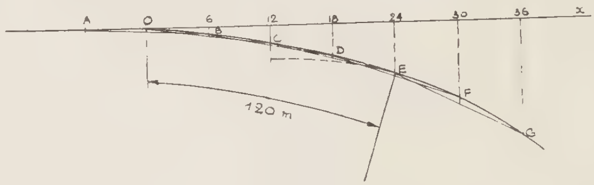
Before explaining the method which allows of doing this without proceeding by trial and error, it will be appropriate to call to mind the relations existing between the versines of two curves, of which the second is obtained from the displacement of the first (1).

Let us assume that f_2, f_3, f_4 are the versines at the marking pegs 2, 3, 4 of a curve, sufficiently close together to allow of the versines being regarded as parallel. (Plate 14). Now let peg 3 be displaced outwards by an amount d_3; its versine then becomes $F'_3 = f_3 + d_3$ and the versines of the adjacent pegs

PLATE 7.

CORRECTION OF CURVES BY MEANS OF TELESCOPE AND SIGHTING BOARD.

EQUATION OF PARABOLIC TRANSITION 120 m. (393 ft. 8 3/8 in.) LONG : $y = \frac{x^3}{6\,L\,R} = \frac{x^3}{720\,R}$.
LENGTH OF THE CHORD : 60 m. (196 ft. 10 1/4 in.).



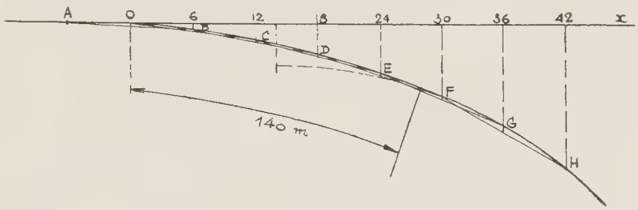
ORDINATES					
Chord AB	Chord OC	Chord BD	Chord CE	Chord DF	Chord EG
$f_0 = \frac{13500}{720R}$	$f_B = \frac{81000}{720R}$	$f_C = \frac{162000}{720R}$	$f_D = \frac{243000}{720R}$	$f_E = \frac{310500}{720R}$	$f_F = \frac{324000}{720R} = \frac{3600}{8R}$
$y_1 = \frac{15625}{720R}$	$y_7 = \frac{83125}{720R}$	$y_{13} = \frac{161875}{720R}$	$y_{19} = \frac{240625}{720R}$	$y_{25} = \frac{303750}{720R}$	$y_{31} = \frac{315000}{720R} = \frac{3500}{8R}$
$y_2 = \frac{17000}{720R}$	$y_8 = \frac{80000}{720R}$	$y_{14} = \frac{152000}{720R}$	$y_{20} = \frac{224000}{720R}$	$y_{26} = \frac{279000}{720R}$	$y_{32} = \frac{288000}{720R} = \frac{3200}{8R}$
$y_3 = \frac{16875}{720R}$	$y_9 = \frac{70875}{720R}$	$y_{15} = \frac{131625}{720R}$	$y_{21} = \frac{192375}{720R}$	$y_{27} = \frac{236250}{720R}$	$y_{33} = \frac{243000}{720R} = \frac{2700}{8R}$
$y_4 = \frac{14500}{720R}$	$y_{10} = \frac{55000}{720R}$	$y_{16} = \frac{100000}{720R}$	$y_{22} = \frac{145000}{720R}$	$y_{28} = \frac{175500}{720R}$	$y_{34} = \frac{180000}{720R} = \frac{2000}{8R}$
$y_5 = \frac{9125}{720R}$	$y_{11} = \frac{31625}{720R}$	$y_{17} = \frac{56375}{720R}$	$y_{23} = \frac{61125}{720R}$	$y_{29} = \frac{96750}{720R}$	$y_{35} = \frac{99000}{720R} = \frac{1100}{8R}$
$y_6 = 0$	$y_{12} = 0$	$y_{18} = 0$	$y_{24} = 0$	$y_{30} = 0$	$y_{36} = 0$

(1) Méthodes de rectification du tracé des courbes des chemins de fer par correction des flèches (Methods of adjusting curves on railways by correction of the versines), par J. CHAPPELLET, Inspecteur au service central de la Voie de la Compagnie du chemin de fer du Nord. Librairie de l'Enseignement technique, 3, rue Thénard, Paris, 1926.

PLATE 8.

CORRECTION OF CURVES BY MEANS OF TELESCOPE AND SIGHTING BOARD.

EQUATION OF PARABOLIC TRANSITION 140 m. (459 ft. 3 3/4 in.) LONG : $y = \frac{x^3}{6\,L\,R} = \frac{x^3}{840\,R}$.
LENGTH OF THE CHORD : 60 m. (196 ft. 10 1/4 in.).



ORDINATES						
Chord AB	Chord OC	Chord BD	Chord CE	Chord DF	Chord EG	Chord FH
$f_O = \frac{13500}{840R}$	$f_B = \frac{81000}{840R}$	$f_C = \frac{162000}{840R}$	$f_D = \frac{243000}{840R}$	$f_E = \frac{323500}{840R}$	$f_F = \frac{374000}{840R}$	$f_G = \frac{378000}{840R} = \frac{3600}{8R}$
$y_1 = \frac{15625}{840R}$	$y_7 = \frac{83125}{840R}$	$y_{13} = \frac{161875}{840R}$	$y_{19} = \frac{240625}{840R}$	$y_{25} = \frac{318792}{840R}$	$y_{31} = \frac{364167}{840R}$	$y_{37} = \frac{367500}{840R} = \frac{3500}{8R}$
$y_2 = \frac{17000}{840R}$	$y_8 = \frac{80000}{840R}$	$y_{14} = \frac{152000}{840R}$	$y_{20} = \frac{224000}{840R}$	$y_{26} = \frac{295333}{840R}$	$y_{32} = \frac{333333}{840R}$	$y_{38} = \frac{336000}{840R} = \frac{3200}{8R}$
$y_3 = \frac{16875}{840R}$	$y_9 = \frac{70875}{840R}$	$y_{15} = \frac{131625}{840R}$	$y_{21} = \frac{192375}{840R}$	$y_{27} = \frac{252375}{840R}$	$y_{33} = \frac{281500}{840R}$	$y_{39} = \frac{283500}{840R} = \frac{2700}{8R}$
$y_4 = \frac{14500}{840R}$	$y_{10} = \frac{55000}{840R}$	$y_{16} = \frac{100000}{840R}$	$y_{22} = \frac{145000}{840R}$	$y_{28} = \frac{169167}{840R}$	$y_{34} = \frac{208667}{840R}$	$y_{40} = \frac{210000}{840R} = \frac{2000}{8R}$
$y_5 = \frac{9125}{840R}$	$y_{11} = \frac{31625}{840R}$	$y_{17} = \frac{56375}{840R}$	$y_{23} = \frac{81125}{840R}$	$y_{29} = \frac{95083}{840R}$	$y_{35} = \frac{114833}{840R}$	$y_{41} = \frac{115500}{840R} = \frac{1100}{8R}$
$y_6 = 0$	$y_{12} = 0$	$y_{18} = 0$	$y_{24} = 0$	$y_{30} = 0$	$y_{36} = 0$	$y_{42} = 0$

become $F'_2 = f_2 - \frac{d_3}{2}$ and $F'_4 = f_4 - \frac{d_3}{2}$.

If we displace outwards simultaneously pegs 2, 3, 4 by the amounts d_2, d_3, d_4, the versine of peg 3, increased by the amount d_3 in consequence of such movement, will be reduced by $\frac{d_2}{2}$ and $\frac{d_4}{2}$, following the change in position of pegs 2 and 4, and will then become :

$$F_3 = f_3 + d_3 - \frac{d_2 + d_4}{2}$$

Applying this formula to the different pegs of the curve ABC which we wish to shift to AB′C′ :

At peg 1 we have :

$$F_1 = f_1 + d_1 - \frac{d_0}{2} - \frac{d_2}{2}$$

$d_0 = d_1 = o$,

from which : $F_1 = f_1 - \frac{d_2}{2}$ and

$$\frac{d_2}{2} = f_1 - F_1.$$

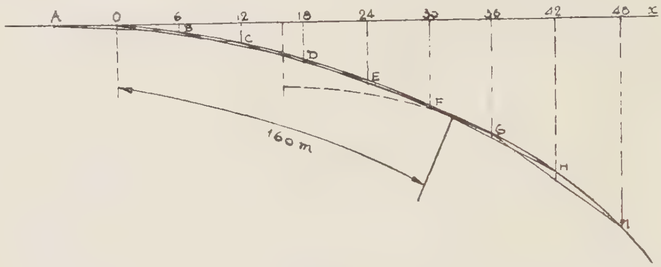
Let us call this difference between the versines δ_1 :

$$d_2 = 2\,\delta_1.$$

PLATE 9.

CORRECTION OF CURVES BY MEANS OF TELESCOPE AND SIGHTING BOARD.

EQUATION OF PARABOLIC TRANSITION 160 m. (524 ft. 11 1/4 in.) LONG : $y = \frac{x^3}{6\,L\,R} = \frac{x^3}{960\,R}$.
LENGTH OF THE CHORD : 60 m. (196 ft. 10 1/4 in.).



ORDINATES							
Chord AB	Chord OC	Chord BD	Chord CE	Chord DF	Chord EG	Chord FH	Chord GI
$f_O = \frac{13500}{960R}$	$f_B = \frac{81000}{960R}$	$f_C = \frac{162000}{960R}$	$f_D = \frac{243000}{960R}$	$f_E = \frac{324000}{960R}$	$f_F = \frac{401000}{960R}$	$f_G = \frac{431500}{960R}$	$f_H = \frac{432000}{960R} = \frac{3600}{8R}$
$y_1 = \frac{15625}{960R}$	$y_7 = \frac{83125}{960R}$	$y_{13} = \frac{161875}{960R}$	$y_{19} = \frac{240625}{960R}$	$y_{25} = \frac{319375}{960R}$	$y_{31} = \frac{383458}{960R}$	$y_{37} = \frac{419583}{960R}$	$y_{43} = \frac{420000}{960R} = \frac{3500}{8R}$
$y_2 = \frac{17000}{960R}$	$y_8 = \frac{80000}{960R}$	$y_{14} = \frac{152000}{960R}$	$y_{20} = \frac{224000}{960R}$	$y_{26} = \frac{296000}{960R}$	$y_{32} = \frac{362667}{960R}$	$y_{38} = \frac{383667}{960R}$	$y_{44} = \frac{384000}{960R} = \frac{3200}{8R}$
$y_3 = \frac{16875}{960R}$	$y_9 = \frac{70875}{960R}$	$y_{15} = \frac{131625}{960R}$	$y_{21} = \frac{192375}{960R}$	$y_{27} = \frac{253125}{960R}$	$y_{33} = \frac{308000}{960R}$	$y_{39} = \frac{323750}{960R}$	$y_{45} = \frac{324000}{960R} = \frac{2700}{8R}$
$y_4 = \frac{14500}{960R}$	$y_{10} = \frac{55000}{960R}$	$y_{16} = \frac{100000}{960R}$	$y_{22} = \frac{145000}{960R}$	$y_{28} = \frac{190000}{960R}$	$y_{34} = \frac{229333}{960R}$	$y_{40} = \frac{239833}{960R}$	$y_{46} = \frac{240000}{960R} = \frac{2000}{8R}$
$y_5 = \frac{9125}{960R}$	$y_{11} = \frac{31625}{960R}$	$y_{17} = \frac{56375}{960R}$	$y_{23} = \frac{81125}{960R}$	$y_{29} = \frac{105875}{960R}$	$y_{35} = \frac{126667}{960R}$	$y_{41} = \frac{131917}{960R}$	$y_{47} = \frac{132000}{960R} = \frac{1100}{8R}$
$y_6 = 0$	$y_{12} = 0$	$y_{18} = 0$	$y_{24} = 0$	$y_{30} = 0$	$y_{36} = 0$	$y_{42} = 0$	$y_{48} = 0$

At peg 2 we have :

$$F_2 = f_2 + d_2 - \frac{d_1}{2} - \frac{d_3}{2} \text{ and}$$

$$\frac{d_3}{2} = f_2 - F_2 + d_2 - \frac{d_1}{2},$$

but $d_2 = 2\,\delta_1$ and $\frac{d_1}{2} = 0$,

whence $\frac{d_3}{2} = f_2 - F_2 + 2\,\delta_1 = \delta_2 + 2\,\delta_1$

$$d_3 = 2\,\delta_2 + 4\,\delta_1.$$

At peg 3, we have :

$$F_3 = f_3 + d_3 - \frac{d_2}{2} - \frac{d_4}{2} \text{ and}$$

$$\frac{d_4}{2} = f_3 - F_3 + d_3 - \frac{d_2}{2}$$

$$\frac{d_4}{2} = \delta_3 + 2\,\delta_2 + 4\,\delta_1 - \delta_1 = \delta_3 + 2\,\delta_2 + 3\,\delta_1.$$

In like manner we find that

$$\frac{d_5}{2} = \delta_4 + 2\,\delta_3 + 3\,\delta_2 + 4\,\delta_1 \quad (1)$$

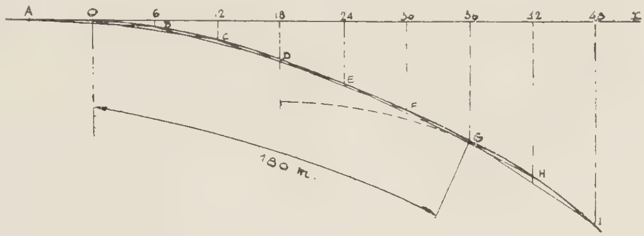
and $\frac{d_6}{2} = \delta_5 + 2\,\delta_4 + 3\,\delta_3 + 4\,\delta_2 + 5\,\delta_1$ (2),

but $d_5 = d_6 = 0$.

PLATE 10.

CORRECTION OF CURVES BY MEANS OF TELESCOPE AND SIGHTING BOARD.

EQUATION OF PARABOLIC TRANSITION 180 m. (590 ft. 6 3/4 in.) LONG : $y = \frac{x^3}{6\,L\,R} = \frac{x^3}{1080\,R}$.
LENGTH OF THE CHORD : 60 m. (196 ft. 10 1/4 in.).



ORDINATES							
Chord AB	Chord OC	Chord BD	Chord CE	Chord DF	Chord EG	Chord FH	Chord GI
$f_O = \frac{13500}{1080R}$	$f_B = \frac{81000}{1080R}$	$f_C = \frac{162000}{1080R}$	$f_D = \frac{243000}{1080R}$	$f_E = \frac{324000}{1080R}$	$f_F = \frac{405000}{1080R}$	$f_G = \frac{472500}{1080R}$	$f_H = \frac{486000}{1080R} = \frac{3600}{8R}$
$y_1 = \frac{15625}{1080R}$	$y_7 = \frac{83125}{1080R}$	$y_{13} = \frac{161875}{1080R}$	$y_{19} = \frac{240625}{1080R}$	$y_{25} = \frac{319375}{1080R}$	$y_{31} = \frac{398125}{1080R}$	$y_{37} = \frac{461250}{1080R}$	$y_{43} = \frac{472500}{1080R} = \frac{3500}{8R}$
$y_2 = \frac{17000}{1080R}$	$y_8 = \frac{80000}{1080R}$	$y_{14} = \frac{152000}{1080R}$	$y_{20} = \frac{224000}{1080R}$	$y_{26} = \frac{296000}{1080R}$	$y_{32} = \frac{368000}{1080R}$	$y_{38} = \frac{423000}{1080R}$	$y_{44} = \frac{432000}{1080R} = \frac{3200}{8R}$
$y_3 = \frac{16875}{1080R}$	$y_9 = \frac{70875}{1080R}$	$y_{15} = \frac{131625}{1080R}$	$y_{21} = \frac{192375}{1080R}$	$y_{27} = \frac{253125}{1080R}$	$y_{33} = \frac{313875}{1080R}$	$y_{39} = \frac{357750}{1080R}$	$y_{45} = \frac{364500}{1080R} = \frac{2700}{8R}$
$y_4 = \frac{14500}{1080R}$	$y_{10} = \frac{55000}{1080R}$	$y_{16} = \frac{100000}{1080R}$	$y_{22} = \frac{145000}{1080R}$	$y_{28} = \frac{190000}{1080R}$	$y_{34} = \frac{235000}{1080R}$	$y_{40} = \frac{265500}{1080R}$	$y_{46} = \frac{270000}{1080R} = \frac{2000}{8R}$
$y_5 = \frac{9125}{1080R}$	$y_{11} = \frac{31625}{1080R}$	$y_{17} = \frac{56375}{1080R}$	$y_{23} = \frac{81125}{1080R}$	$y_{29} = \frac{105875}{1080R}$	$y_{35} = \frac{130625}{1080R}$	$y_{41} = \frac{146250}{1080R}$	$y_{47} = \frac{148500}{1080R} = \frac{1100}{8R}$
$y_6 = 0$	$y_{12} = 0$	$y_{18} = 0$	$y_{24} = 0$	$y_{30} = 0$	$y_{36} = 0$	$y_{42} = 0$	$y_{48} = 0$

The formula (2) is therefore written :

$$\delta_5 + 2\,\delta_4 + 3\,\delta_3 + 4\,\delta_2 + 5\,\delta_1 = 0 \quad (3)$$

and the formula (1)

$$\delta_4 + 2\,\delta_3 + 3\,\delta_2 + 4\,\delta_1 = 0 \quad (4)$$

whence, by substraction :

$$\delta_5 + \delta_4 + \delta_3 + \delta_2 + \delta_1 = 0$$

$$\text{or } \Sigma\,\delta = \Sigma\,(f - F) = 0$$

or again $\Sigma f = \Sigma F$. (6)

Returning now to the rectification of the portion BHC′ (Plate 13).

The versines f_B, f_H and $f_{C'}$ are measured. Let f'_B, $f'_{H'}$ and $f'_{C'}$ be those to be obtained.

Points B and C′ being already corrected, it is possible to write, using the relation (6) :

$$f_B + f_H + f_{C'} = f'_B + f'_{H'} + f'_{C'}$$

The curve BH′C′ to be obtained comprises two circular arcs HB′ and H′C′, both tangent at point H′, and also, respectively, at the points B and C′ to the circular curves already rectified.

Under these conditions :

$$f_E = f_1$$

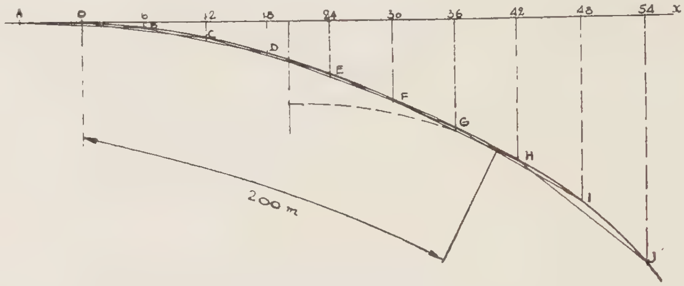
$$f'_B = \frac{f_1 + f_2}{2}$$

$$f'_{H'} = \frac{f_2 + f_3}{2}$$

PLATE 11.

CORRECTION OF CURVES BY MEANS OF TELESCOPE AND SIGHTING BOARD.

EQUATION OF PARABOLIC TRANSITION 200 m. (656 ft. 2 in.) LONG : $y = \frac{x^3}{6\,L\,R} = \frac{x^4}{1200\,R}$.
LENGTH OF THE CHORD : 60 m. (196 ft. 10 1/4 in.).



ORDINATES								
Chord AB	Chord OC	Chord BD	Chord CE	Chord DF	Chord EG	Chord FH	Chord GI	Chord HJ
$f_O = \frac{13500}{1200R}$	$f_B = \frac{81000}{1200R}$	$f_C = \frac{162000}{1200R}$	$f_D = \frac{243000}{1200R}$	$f_E = \frac{324000}{1200R}$	$f_F = \frac{405000}{1200R}$	$f_G = \frac{485500}{1200R}$	$f_H = \frac{536000}{1200R}$	$f_I = \frac{540000}{1200R} = \frac{3600}{8R}$
$y_1 = \frac{15625}{1200R}$	$y_7 = \frac{83125}{1200R}$	$y_{13} = \frac{161875}{1200R}$	$y_{19} = \frac{240625}{1200R}$	$y_{25} = \frac{319375}{1200R}$	$y_{31} = \frac{398125}{1200R}$	$y_{37} = \frac{476292}{1200R}$	$y_{43} = \frac{521667}{1200R}$	$y_{49} = \frac{525000}{1200R} = \frac{3500}{8R}$
$y_2 = \frac{17000}{1200R}$	$y_8 = \frac{80000}{1200R}$	$y_{14} = \frac{152000}{1200R}$	$y_{20} = \frac{224000}{1200R}$	$y_{26} = \frac{296000}{1200R}$	$y_{32} = \frac{368000}{1200R}$	$y_{38} = \frac{439333}{1200R}$	$y_{44} = \frac{477333}{1200R}$	$y_{50} = \frac{480000}{1200R} = \frac{3200}{8R}$
$y_3 = \frac{16875}{1200R}$	$y_9 = \frac{70875}{1200R}$	$y_{15} = \frac{131625}{1200R}$	$y_{21} = \frac{192375}{1200R}$	$y_{27} = \frac{255125}{1200R}$	$y_{33} = \frac{313875}{1200R}$	$y_{39} = \frac{373875}{1200R}$	$y_{45} = \frac{403000}{1200R}$	$y_{51} = \frac{405000}{1200R} = \frac{2700}{8R}$
$y_4 = \frac{14500}{1200R}$	$y_{10} = \frac{55000}{1200R}$	$y_{16} = \frac{100000}{1200R}$	$y_{22} = \frac{145000}{1200R}$	$y_{28} = \frac{190000}{1200R}$	$y_{34} = \frac{235000}{1200R}$	$y_{40} = \frac{279167}{1200R}$	$y_{46} = \frac{298667}{1200R}$	$y_{52} = \frac{300000}{1200R} = \frac{2000}{8R}$
$y_5 = \frac{9125}{1200R}$	$y_{11} = \frac{31625}{1200R}$	$y_{17} = \frac{56375}{1200R}$	$y_{23} = \frac{81125}{1200R}$	$y_{29} = \frac{105875}{1200R}$	$y_{35} = \frac{130625}{1200R}$	$y_{41} = \frac{154583}{1200R}$	$y_{47} = \frac{164333}{1200R}$	$y_{53} = \frac{165000}{1200R} = \frac{1100}{8R}$
$y_6 = 0$	$y_{12} = 0$	$y_{18} = 0$	$y_{24} = 0$	$y_{30} = 0$	$y_{36} = 0$	$y_{42} = 0$	$y_{48} = 0$	$y_{54} = 0$

$$f'_{C'} = \frac{f_3 + f_1}{2}$$

$$f_{F'} = f_1$$

whence :

$$f_B + f_H + f_{C'} = f'_B + f'_{H'} + f'_{C'} =$$

$$\frac{f_1 + f_2}{2} + \frac{f_2 + f_3}{2} + \frac{f_3 + f_1}{2} = f_1 + f_2 + f_3$$

$$f_1 = f_E$$

$$f_2 + f_3 = 2\,f'_{H'}$$

therefore

$$f_B + f_H + f_{C'} = f_E + 2\,f'_{H'},$$

whence

$$f'_{H'} = \frac{f_B + f_H + f_{C'}}{2} - \frac{f_E}{2}$$

Numerical example :

$f_E = f_{F'} =$ 450 mm. (R = 1 000 m.). f_B = 474 mm. f_H = 420 mm. and $f_{C'}$ = 476 mm.

$$f'_{H'} = \frac{474 + 420 + 476}{2} - \frac{450}{2} = 460 \text{ mm.}$$

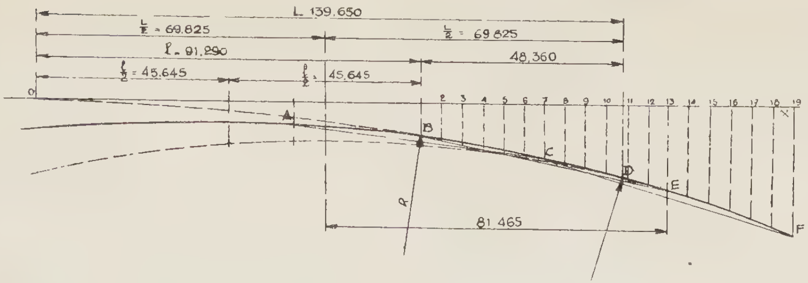
Consequently the point H in the track needs to be slewed by the amount 460 — 420 = 40 mm. (1 9/16 in.) outwards from the curve.

From this fact it follows that the versines of the arcs EBH′ and H′B′F′ are :

CORRECTION OF CURVES BY MEANS OF TELESCOPE AND SIGHTING BOARD.

PARABOLIC TRANSITION BETWEEN TWO CURVES OF SIMILAR DIRECTION.

Example of the calculation of versines and ordinates with reference to a 60 m. (196 ft. 10 1/4 in.) chord.



DATA :

$R = 823\,m \quad r = 538\,m \quad L-\ell = 48{,}36\,m$

$\ell = \frac{Lr}{R} = \frac{538}{823}L$

$L-\ell = L - \frac{538}{823}L = \frac{285}{823}L = 48{,}36\,m.$

$L = 139{,}65\,m. \quad \ell = 139{,}65 - 48{,}36 = 91{,}29\,m.$

$y_A = \frac{L^2}{24R} + \frac{(\frac{\ell}{2}-30)^2}{2R} = 0{,}57\,m.$

$y_B = \frac{\ell^2}{6B} = 1{,}688\,m$

$y_C = \frac{x^3}{6Lr} = \frac{121{,}29^3}{6 \times 139{,}65 \times 538} = 3{,}958\,m$

$y_E = \frac{L^2}{6r} + \frac{(\ell+60-\frac{L}{2})^2-(\frac{L}{2})^2}{2r} = \frac{139{,}65^2}{6 \times 538} + \frac{81{,}465^2 - 69{,}825^2}{2 \times 538} = 7{,}679\,m$

$y_F = y_E + \frac{111{,}465^2 - 81{,}465^2}{2 \times 538} = 13{,}059\,m.$

Ordinates of the chord AC	Ordinates of the arc BC	Ordinates of the arc BC with respect to the chord AC
$y_B = \frac{y_A+y_C}{2} = 2{,}264\,m$ $y_2 = 2{,}264 + \frac{1}{6}(y_C - y_B) = 2{,}546\,m$ $y_3 = 2{,}264 + \frac{2}{6}(y_C - y_B) = 2{,}828\,m$ $y_4 = 2{,}264 + \frac{3}{6}(y_C - y_B) = 3{,}111\,m$ $y_5 = 2{,}264 + \frac{4}{6}(y_C - y_B) = 3{,}393\,m$ $y_6 = 2{,}264 + \frac{5}{6}(y_C - y_B) = 3{,}676\,m$ $y_7 = y_C = 3{,}958\,m.$	$y_B = 1{,}688\,m$ $y_2 = \frac{96{,}29^3}{6 \times 139{,}65 \times 538} = 1{,}980\,m$ $y_3 = \frac{101{,}29^3}{6Lr} = 2{,}305\,m$ $y_4 = \frac{106{,}29^3}{6Lr} = 2{,}664\,m.$ $y_5 = \frac{111{,}29^3}{6Lr} = 3{,}058\,m$ $y_6 = \frac{116{,}29^3}{6Lr} = 3{,}488^5\,m.$ $y_7 = y_C = 3{,}958\,m.$	$f_B = 0{,}576\,m$ $y_2 = 0{,}566\,m$ $y_3 = 0{,}524\,m$ $y_4 = 0{,}447\,m$ $y_5 = 0{,}335\,m.$ $y_6 = 0{,}187^5\,m$ $y_7 = 0$
Ordinates of the chord BE	**Ordinates of the arc CE**	**Ordinates of the arc CE with respect to the chord BE**
$y_C = \frac{y_B+y_E}{2} = 4{,}683^5\,m$ $y_8 = 4{,}683^5 + \frac{1}{6}(y_E - y_C) = 5{,}183\,m$ $y_9 = 4{,}683^5 + \frac{2}{6}(y_E - y_C) = 5{,}682\,m$ $y_{10} = 4{,}683^5 + \frac{3}{6}(y_E - y_C) = 6{,}181\,m$ $y_D = 4{,}683^5 + (y_E - y_C) \times \frac{10{,}58}{30} = 6{,}517\,m$ $y_{11} = 4{,}683^5 + \frac{4}{6}(y_E - y_C) = 6{,}680^5\,m$ $y_{12} = 4{,}683^5 + \frac{5}{6}(y_E - y_C) = 7{,}180\,m$ $y_{13} = y_E = 7{,}679\,m$	$y_C = 3{,}958\,m.$ $y_8 = \frac{126{,}29^3}{6Lr} = 4{,}468\,m$ $y_9 = \frac{131{,}29^3}{6Lr} = 5{,}020\,m.$ $y_{10} = \frac{136{,}29^3}{6Lr} = 5{,}616\,m.$ $y_D = \frac{139{,}65^3}{6Lr} = 6{,}042\,m.$ $y_{11} = 6{,}042 + \frac{71{,}465^2 - 69{,}825^2}{2 \times 538} = 6{,}257\,m$ $y_{12} = 6{,}042 + \frac{76{,}465^2 - 69{,}825^2}{2r} = 6{,}945\,m.$ $y_{13} = 6{,}042 + \frac{81{,}465^2 - 69{,}825^2}{2r} = 7{,}679\,m.$	$f_C = 0{,}725^5\,m.$ $y_8 = 0{,}715\,m.$ $y_9 = 0{,}662\,m.$ $y_{10} = 0{,}565\,m.$ $y_D = 0{,}475\,m.$ $y_{11} = 0{,}423^5\,m$ $y_{12} = 0{,}235\,m.$ $y_{13} = 0.$
Ordinates of the chord CF	**Ordinates of the arc EF**	**Ordinates of the arc EF with respect to the chord CF**
$y_E = \frac{y_C+y_F}{2} = 8{,}508^5\,m$ $y_{14} = 8{,}508^5 + \frac{1}{6}(y_F - y_E) = 9{,}267\,m.$ $y_{15} = 8{,}508^5 + \frac{2}{6}(y_F - y_E) = 10{,}025\,m$ $y_{16} = 8{,}508^5 + \frac{3}{6}(y_F - y_E) = 10{,}784\,m$ $y_{17} = 8{,}508^5 + \frac{4}{6}(y_F - y_E) = 11{,}542\,m.$ $y_{18} = 8{,}508^5 + \frac{5}{6}(y_F - y_E) = 12{,}300^5\,m$ $y_{19} = y_F = 13{,}059\,m.$	$y_E = 7{,}679\,m$ $y_{14} = 7{,}679 + \frac{86{,}465^2 - 81{,}465^2}{2r} = 8{,}459^5\,m.$ $y_{15} = 7{,}679 + \frac{91{,}465^2 - 81{,}465^2}{2r} = 9{,}286\,m$ $y_{16} = 7{,}679 + \frac{96{,}465^2 - 81{,}465^2}{2r} = 10{,}160\,m$ $y_{17} = 7{,}679 + \frac{101{,}465^2 - 81{,}465^2}{2r} = 11{,}080\,m.$ $y_{18} = 7{,}679 + \frac{106{,}465^2 - 81{,}465^2}{2r} = 12{,}046\,m$ $y_{19} = 7{,}679 + \frac{111{,}465^2 - 81{,}465^2}{2r} = 13{,}059\,m$	$f_E = 0{,}829^5\,m.$ $y_{14} = 0{,}807^5\,m.$ $y_{15} = 0{,}759\,m$ $y_{16} = 0{,}624\,m.$ $y_{17} = 0{,}462\,m.$ $y_{18} = 0{,}254\,m$ $y_{19} = 0.$

PLATE 13.

$$f'_{B} = 474 - \frac{40}{2} = 454;$$

$$f'_{C'} = 476 - \frac{40}{2} = 456.$$

The versine $f_2 = 2\, f'_{B} - f_1 = 2 \times 454 - 450 = 458$ mm. (1 ft. 6 in.)

The versine $f_3 = 2\, f'_{C'} - f_1 = 2 \times 456 - 450 = 462$ mm. (1 ft. 6 13/64 in.)

The ordinates of the circular arc BH′ referred to the chord subtending an arc of 60 m. (196 ft. 10 1/4 in.) of which the versine f_2 is equal to 458 mm. (1 ft. 6 in.) are respectively :

$$y_{H'} = 0 \text{ mm.}$$

$$y_1 = \frac{11 \times 458}{36} = 140 \text{ mm. (5 1/2 in.)}$$

$$y_2 = \frac{20 \times 458}{36} = 254 \text{ mm. (10 in.)}$$

$$y_3 = \frac{27 \times 458}{36} = 343 \text{ mm. (1 ft. 1 1/2 in.)}$$

$$y_4 = \frac{32 \times 458}{36} = 407 \text{ mm. (1 ft. 4 1/32 in.)}$$

$$y_5 = \frac{35 \times 458}{36} = 445 \text{ mm. (1 ft. 5 57/64 in.)}$$

$$f_2 = 458 \text{ mm. (1 ft. 6 in.)}$$

The circular arc BH is then corrected with respect to the visual chord of the half arc EB, of which the versine f_1 equals 450 mm. (1 ft. 5 11/16 in.), a chord parallel to the preceding one.

The ordinates calculated above have therefore to be diminished by 458 — 450 = 8 mm. (5/16 in.)

They are therefore as follows :

$y'_{H'}$ = 0 — 8 = — 8 mm. (5/16 in.)

y'_1 = 140 — 8 = 132 mm. (5 13/64 in.)

y'_2 = 254 — 8 = 246 mm. (9 43/64 inch.)

y'_3 = 343 — 8 = 335 mm. (1 ft. 1 13/64 in.)

y'_4 = 407 — 8 = 399 mm. (1 ft. 3 6/8 in.)

y'_5 = 445 — 8 = 437 mm. (1 ft. 5 7/32 in.)

f_1 = 450 mm. (1 ft. 5 11/16 in.)

In order to correct the circular arc BH, the telescope is placed on the rail at point E and the sliding board at B. The white mark on the red screen is brought into agreement with the 450 mm. (1 ft. 5 11/16 in.) graduation on the board. The telescope is then adjusted so that the vertical cross-wire corresponds with the white mark of the red screen, after which the telescope is locked in position by means of the setscrew. The sliding board is then moved to H, the telescope is set for this new position of the sighting board and the white mark of the red screen made to agree with the graduation corresponding to the ordinate $y'_{H'}$ = — 8 mm. (5/16 in.) of the curve BH′.

The track is then slewed where the board stands so as to make the vertical cross-wire coincide with the white mark on the red screen. This corrects the track at this point. The sliding board is then shifted 5 m. (16 ft. 5 in.) towards the telescope and the white mark of the red screen made to agree with the graduation of the sighting board corresponding to the ordinate y'_1 = 132 mm. (5 13/64 in.) of the curve BH′. The track is then slewed in the neighbourhood of the sighting board to make the vertical cross-wire agree with the white mark of the red screen and is in this way corrected at this point. The sliding board is once again moved 5 m. (16 ft. 5 in.) towards the telescope and the process is repeated every 5 m. (16 ft. 5 in.) up to the point B. In this way, the section of the track BH will have been completely corrected.

The ordinates of the circular arc C′H′ referred to the chord subtending an arc of 60 m. (196 ft. 10 1/4 in.), the versine f_3 of which equals 462 mm. (1 ft. 6 13/64 in.), are respectively as follows :

$$y_{H'} = 0.$$

$$y_6 = \frac{11 \times 462}{36} = 141 \text{ mm. (5 35/64 in.)}$$

$$y_7 = \frac{20 \times 462}{36} = 257 \text{ mm. (10 4/32 in.)}$$

$$y_8 = \frac{27 \times 462}{36} = 346 \text{ mm. (1 ft. 39/64 in.)}$$

$$y_9 = \frac{32 \times 462}{36} = 411 \text{ mm. (1 ft. 4 11/64 in.)}$$

$$y_{10} = \frac{35 \times 462}{36} = 449 \text{ mm. (1 ft. 5 41/64 in.)}$$

$$f_3 = 462 \text{ mm. (1 ft. 6 13/64 in.)}$$

The circular arc C′H is corrected with respect to the visual chord of the half-arc F′C′, the versine f_1 of which is equal to 450 mm. (1 ft. 5 11/16 in.), a chord parallel to the preceding. The ordinates calculated as above have then to be diminished by 462 — 450 = 12 mm. (15/32 in.)

They are therefore respectively :

$$y'_{H'} = 0 - 12 = -12 \text{ mm. (15/32 in.)}$$
$$y'_6 = 141 - 12 = 129 \text{ mm. (5 5/64 in.)}$$
$$y'_7 = 257 - 12 = 245 \text{ mm. (9 10/16 in.)}$$
$$y'_8 = 346 - 12 = 334 \text{ mm. (1 ft. 1 5/32 in.)}$$
$$y'_9 = 411 - 12 = 399 \text{ mm. (1 ft. 3 6/8 in.)}$$
$$y'_{10} = 449 - 12 = 437 \text{ mm. (1 ft. 5 7/32 in.)}$$
$$f_1 = 450 \text{ mm. (1 ft. 5 11/16 in.)}$$

In order to correct the circular arc C′H, the telescope is placed on the rail at F′ and the sliding board at C′. The white mark on the red screen is made to agree with the graduation mark of 450 mm. (1 ft. 5 11/16 in.) on the board. The telescope is then set so as to bring the vertical cross-wire into agreement with the white mark of the red screen and locked in that position. The sliding board is then placed on the rail at H, the telescope is set for this new position and the white mark on the red screen made to coincide with the graduation on the board corresponding to the ordinate $y'_{H'} = -12$ mm. (15/32 in.) of the curve C′H′.

The point H already having been corrected in an earlier process, it is essential that for this position of the red screen, the vertical cross-wire should agree with the axis of the white mark. The remainder of the process of correction between points H′ and C′ is effected as already explained.

§ 7. — *The successive operations involved in rectifying curves.*

A. Let us first take the case of a circular curve joined to two pieces of straight track by parabolic transitions.

1. The layout is first corrected as closely as possible in relation to the marking pegs.

2. The alignments on one side and the other of the curve are corrected in conformity with the details given in Chapter I, § 2.

3. The commencing points of the

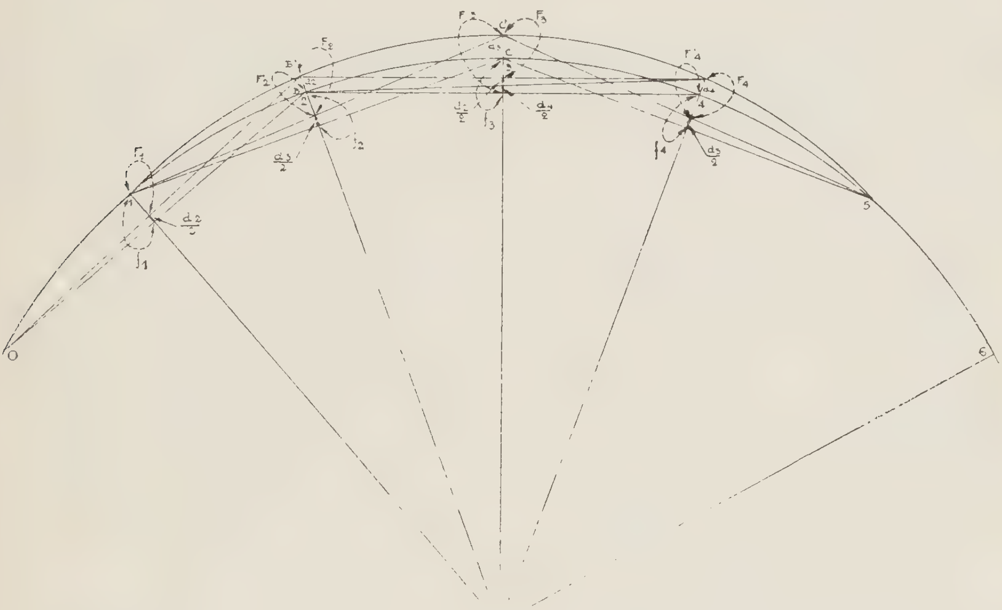
parabolic transition curves connecting the straight sections with the curve are located as exactly as possible. These serve as points of departure from which to determine where to put the telescope and the sliding board, both for measuring the versines of the circular part of the layout which is to be corrected and the whole curved part, including the parabolic portions. This determination is effected by starting from the points of origin of the parabolas and going towards the centre of the circular curve, until within at least 2.5 m. (8 ft. 2 7/16 in.) of that point.

4. The points where the telescope and board are to go are marked out with the greatest care, on the outer side of the head of the outer rail of the circular curve by means of a steel wire provided with two grip handles, which serve to facilitate its handling and thus the marking of the points in question (Fig. 13, Plate 15).

The length of wire between the points is 5 m. (16 ft. 5 in.) when stretched taut; it is provided with a means of adjustment.

To effect this mark locating with due care, the outer side of the head of the rail is chalked and the marks made with a scriber.

PLATE 14.

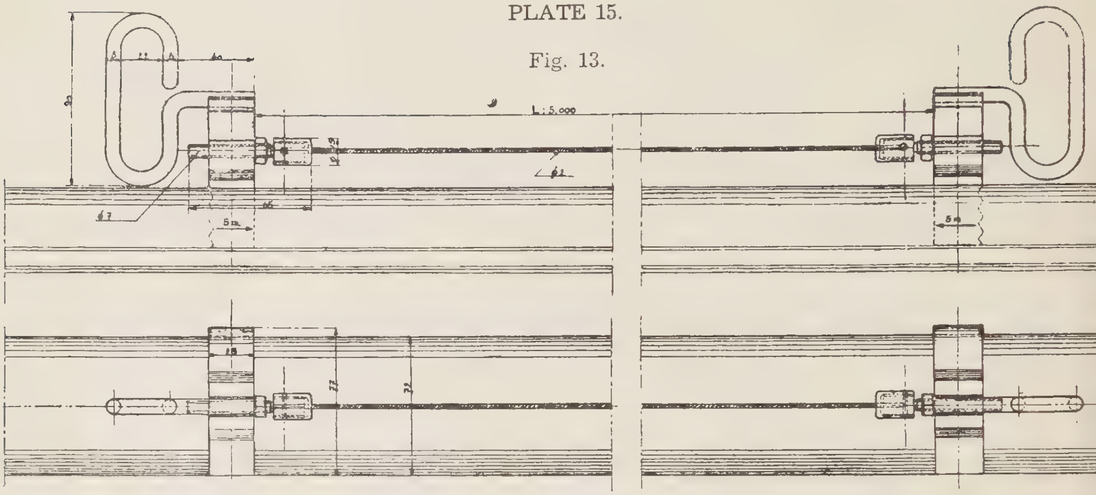


For the radii usually met with, the length of a circular arc subtended by a chord of 5 m. (16 ft. 5 in.) is itself practically equal to that figure. The amount of variation between an arc of a circle of 60 m. (196 ft. 10 1/4 in.) [12 intervals of 5 m. (16 ft. 5 in.)] and the subtending chord is small enough to be neglected in practice.

If we consider a circular curve of 300 m. (984 ft. 3 in.) radius, the subtending chord of a 60 m. (196 ft. 10 1/4

PLATE 15.

Fig. 13.



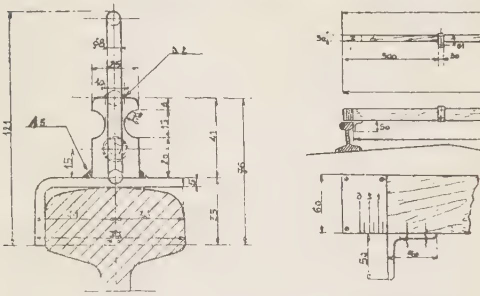


Fig. 14.

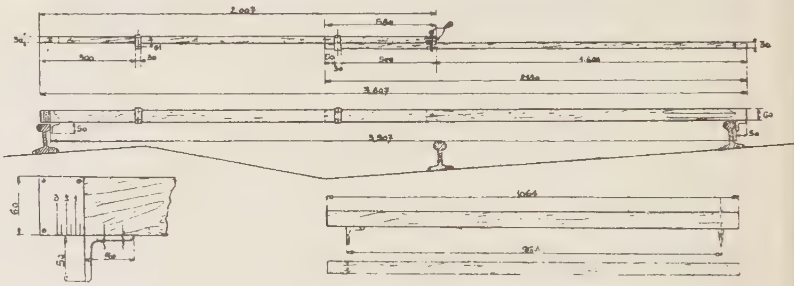


Fig. 15.

in.) arc measures 59.9 m. (196 ft. 6 1/2 in.).

The variation in the measurements of the versines for a 60 m. (196 ft. 10 1/4 in.) and a 59.9 m. (196 ft. 6 1/2 in.) chord is equal to :

$$\frac{60^2}{8 \times R} - \frac{59.9^2}{8 \times R} = \frac{3\,600 - 3\,588}{8 \times 300} =$$

$= 0.005$ m. (13/64 in.), i.e. $\frac{1}{300}$ of the versine of a 60 m. (196 ft. 10 1/4 in.) chord [$f_{60} = 1.50$ m. (4 ft. 11 1/16 in.)]

If we consider a circular curve of 600 m. (1 968 ft. 6 in.) radius, the substending chord of a 60 m. (196 ft. 10 1/4 in.) arc meusures 59.975 m. (196 ft. 9 29/64 in.).

The difference between the versines in this case is

$$\frac{60^2 - 59.975^2}{8 \times 600} = \frac{3\,600 - 3\,597}{4\,800} =$$

$$\frac{3}{4\,800} = \frac{1}{1\,600} = 0^{m}.000625,$$

i.e. $\frac{1}{1\,200}$ of the versine for a 60 m. (196 ft. 10 1/4 in.) chord. [$f_{60} = 0.75$ m. (2 ft. 5 1/2 in.)].

The versines of the circular portion of the layout are then ascertained with

great care at 30 m. (98 ft. 5 1/8 in.) intervals. With this object the telescope is placed vertically in position on the rail, at one end of the portion and at one of the points scribed on the outer side of the rail head. The sliding board is then set 60 m. (196 ft. 10 1/4 in.) away, at another such point. The telescope is then adjusted to make the vertical cross-wire coincide with the white mark on the blue screen and locked in position. The sliding board is then brought back a distance of 30 m. (98 ft. 5 1/8 in.) and the versine is measured by moving the red screen until it is in agreement with the vertical cross-wire.

The versines are measured at 30 m. (98 ft. 5 1/8 in.) intervals with respect to 60 m. (196 ft. 10 1/4 in.) chords until the centre point of the circular curve has practically been reached. The process is then repeated by starting from the other end of the circular curve, being sure always to place the telescope and the board exactly at the points marked on the outer side of the head of the rail.

5. The average versine is found by

$$f_m = \frac{\Sigma f}{n},$$

n being the number of versines measured.

6. The radius of the circular curve is got from :

$$R = \frac{60^2}{8 f_m} = \frac{450}{f_m}.$$

Important note.

In cases where the development of the circular curve is small, it may become necessary to determine its radius by means of a visual chord of less length, 20 or 30 m. (65 ft. 7 3/8 in. or 98 ft. 5 1/8 in.).

The rectification of the line of track can still be effected by means of the 60 m. (196 ft. 10 1/4 in.) chord, making use of the calculation tables given in plates 3 to 11.

7. The process of correction is carried out, as already described in 4 above, starting at the points where the parabolic transitions begin. The locating point of the base of the telescope, which must coincide with one of the marks scribed on the outer side of the rail head, is the point A′ on the optical axis of the sighting tube (fig. 2).

The locating point of the sliding board is the point B, a projection on the base on the support of the axis of the white mark on the blue screen, the starting point of the graduated scale on the board. (Plate 2).

It is these points A′ and B which have to correspond with the locating marks scribed on the outer side of the head of the rail.

The sliding board comprises two faces: the locating point for the second face is the point B′ (Plate 2).

The vertical edges of the small opening in the fixed support facilitate the correct setting of the sliding board (Plate 2).

It should be noted that this board has to be set perpendicularly to the track, the fixed support or stop bearing against the outer edge of the rail to be corrected.

On double track lines care must be taken to make sure during the course of the work that the distance between tracks does not become less than 2 m. (6 ft. 6 3/4 in.). If necessary the adjacent track must be moved away a little.

8. When one line of a double track has to be corrected, the second one is dealt with by making it agree with the first, except in those exceptional cases where the two are not concentric.

For this purpose a wooden straightedge is used, provided with two metal stops placed 3.507 m. (11 ft. 6 3/32 in.) apart (Fig. 14, Plate 15). A scale graduated in millimetres, beginning at one of the stops, allows of any wideness to gauge that may exist being taken into account.

This straightedge has a sliding adjustment to facilitate its being carried about, and has a plug for engaging with the corresponding holes in its two parts, and giving the spacing of the stops, which is 3.507 m. (11 ft. 6 3/32 in.).

Immediately after effecting a correction of the track, the correction of the marking pegs or other signs is carried out by using a small straightedge, 0.964 m. (3 ft. 1 29/32 in.) long (Fig. 15, Plate 15), applied to the corrected inside rail.

B. Let us now consider the case of a layout comprising successively a piece of straight track, a parabolic transition, a circular curve of radius R, a parabolic transition between the latter and another circular curve in the same direction, of radius r, followed by a parabolic transition leading to another section of straight track. The method of procedure is as follows :

1. The track is first set as correctly as possible with respect to the marking pegs.

2. The straight sections on each side of the curved part are connected in the manner described in Chapter I, § 2.

3. The points where the parabolic transitions begin in each case are ascertained with as much exactitude as possible.

The ends of the parabolic transitions between the two curves of radii R and r are determined by the corresponding marking pegs.

4. The scribe marks on the side of the outer rail of the curve, indicating where to set the apparatus, are located with the greatest care.

The points of origin of all these locating points are those of the parabolic transitions between straight tracks and curves and also point B, corresponding to one of the ends of the parabola between the curves of radii R and r.

5. The radii of the two circular curves are ascertained with great care, as already indicated.

Let 100 m. and 140 m. (328 ft. 1 in. and 459 ft. 3 3/4 in.) be the lengths of the parabolic transitions between straight track and the curves of radii $R = 823$ m. (2 700 ft. 1 1/4 in.) and $r = 538$ m. (1 765 ft. 1 in.) and $L - l = 48.36$ m. (158 ft. 7 15/16 in.), the length of the transition between the two curves.

Knowledge of these particulars enables all the calculations to be made effecting the correction of the layout.

Plate 12 gives the elements of the calculation referring to the parabolic transitions connecting the two curves. Plates 6 and 8 allow of determining, as a function of the radius, with the aid of a slide-rule, the elements necessary for correcting the parabolas uniting the straight sections and the circular curves.

6. These elements having been obtained, the layout is corrected in the following manner :

a) The process of correction is begun

at the point of origin of the transition connecting the straight track to the curve of radius *r* and followed out as far as point A of the layout represented in Plate 12, 30 m. (98 ft. 5 1/8 in.) beyond the transition connecting the curve of radius *r* to the curve of radius R;

b) Then, or at the same time, if enough instruments are available, the parabola tangent to the straight track and the curve of radius R is corrected, as well as that portion of the circular curve contained between the parabola and a point G, 60 m. (196 ft. 10 1/4 in.) from point A of the layout shown in Plate 12;

c) The connecting portion between points A and G is then corrected, as set forth in § 6 above.

In setting up this transition on the side where the curve of larger radius is met with, radii smaller than $r = 538$ m. (1 765 ft. 1 in.) are avoided.

7. The second track is then corrected by reference to the first, and finally the marking pegs too, if necessary.

[656. 254 (.73)]

Train communication squared away in 1945,

by John H. Dunn,
Signal and Communications Editor.

(From the *Railway Age*.)

In the field of train communication the most important happenings during the year 1945 were the actions by the Federal Communications Commission to allocate frequencies for railroad radio and to issue rules and regulations for railroad radio service including facilities for train communication as well as between railroad offices. The announcement included a statement that the commission is considering the possibility of relaxing the present low power rule concerning railroad inductive or carrier current train communication systems. In the meantime the end of the war permitted manufacturers to reconvert to the construction of railroad equipment on a production basis. Therefore all factors are now squared away for extensive installation of train communication in 1946, except for a discordant note from the Interstate Commerce Commission.

Conductor in caboose using train telephone during tests on the Milwaukee.

During 1945 the Kansas City Southern proceeded with an installation of the induction carrier system using apparatus made by Aireon Manufacturing Corporation. The project extends on 650 miles of single-track main line between Kansas City, Mo., and Shreveport, La., with equipment at 20 stations in addition to two yard offices in Kansas City, the dispatchers' offices at Pittsburg, Kan., Heavener, Okla., and Schreveport, La., as well as the superintendent's office at Pittsburg. Four road freight locomotives, one Diesel-electric passenger locomotive, four cabooses and one business car are equipped. The wayside stations were completed early in 1945, and the installations on locomotives and cars were completed on July 31, and have been in regular service since.

The Pennsylvania has placed orders with the Union Switch & Signal Company for inductive train communication equipment to be installed by the railroad on 245 miles of four-track line between Harrisburg, Pa., and Pittsburg, including 275 locomotives, 90 cabooses and 6 wayside stations.

The Atlantic Coast Line has ordered inductive type train communication equipment from the Union Switch & Signal Company for installation on 234 miles between Rocky Mount. N. C., and Florence, S. C., via Wilmington, N. C., including 20 road locomotives, 14 cabooses and 4 wayside stations.

The Kansas City Southern has train communication in service on 650 miles including 10 mobiles units and 26 wayside offices.

The Denver & Rio Grande Western has ordered equipment for end-to-end and train-to-wayside train communication on 575 miles between Denver and Salt Lake City, including apparatus for 15 Diesel-electric freight locomotives, 15 cabooses and 10 wayside stations. Radio at very high frequency wil be used for the end-to-end communication, and in addition the cabooses wil be equipped with low-frequency carrier-induction units for communication with wayside stations in a range of up to about 75 miles. This communication equipment, made by the Aireon Manufacturing Corporation, is being delivered now, and installation work is scheduled to start January 15.

The Missouri Pacific has announced a project of train communication on 193 miles of single track between McGehee, Ark., and Alexandria, La., including 15 steam locomotives, 15 cabooses and 7 wayside stations. Radio equipment is to be used for communication between locomotives and cabooses, and inductive-carrier apparatus between cabooses and wayside stations.

The New York Central System is now receiving an installing train communication equipment on 141 miles between Indianapolis, Ind., and Springfield, Ohio, including equipment on 10 locomotives, 10 cabooses and 20 wayside stations. This apparatus is of the induction-carrier type furnished by the Aireon Manufacturing Corporation.

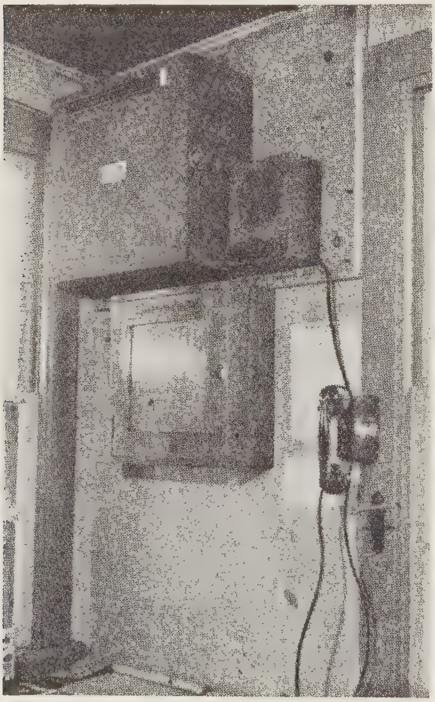
Most everybody made tests.

Space is not available here to recount all the tests of train communication made by the railroads during 1945. Typical instances only, therefore, will be discussed. In April, 1945, the New York, New Haven & Hartford made a test of train communication in electrified territory using equipment furnished by the Westinghouse Electric Corporation. Early in 1945 the Milwaukee made tests of the Union Switch & Signal Company inductive system in electrified territory through tunnels and mountainous country in Washington and Montana. This same type of equipment is now being made on a production basis for deliveries to the Pennsylvania and the Atlantic Coast Lines, as noted previously.

Radio telephone train communication using apparatus made by the Bendix Radio Division of the Bendix Aviation Corporation was tested during 1945 in road service on many railroads, including the Burlington between Chicago and Denver; the Baltimore & Ohio between Baltimore, Md., and Willard, Ohio; the Santa Fe between Chicago and San Francisco; the Denver & Rio Grande Western between Denver and Salt Lake City; the Chicago & North Western between Chicago and Clinton, Iowa; the Northern Pacific between St. Paul and

Seattle; the Great Northern on the Iron Range; and also on various territories on the Milwaukee, the Lackawanna, Florida East Coast, Southern Pacific, St. Louis-San Francisco, Gulf, Mobile & Ohio and the New York, Ontario & Western.

The equipment used on these tests was designed during the war for military uses. Based on experience gained on these and previous tests the Bendix Corporation designed new equipment especially for railroad service, and these new types of units are now being manufactured on a production basis so that they can be delivered in quantities early in 1946. The first deliveries in limited quantities are scheduled for the Northern Pacific, the Milwaukee and the Santa Fe.



Induction carrier train communication in wayside office on Illinois Central.

Tests on some other roads.

As explained in the discussion of permanent installations, the Kansas City Southern has an extensive project using apparatus made by the Aireon Manufacturing Corporation, and this type of equipment was used in tests on numerous other roads including the Illinois Central; the Gulf, Mobile & Ohio; the New York Central; the Denver & Rio Grande Western; the Southern Pacific; the Alton; the Erie; as well as the National Railways of Mexico. On the Illinois Central, tests were made of not only the induction-carrier system but also the high-frequency straight radio apparatus also made by Aireon.

On the Chicago, Rock Island & Pacific, frequency-modulation radio telephone equipment made by the General Electric Company has recently been installed on three Diesel-electric freight locomotives and three cabooses used in fast through freight service between Rock Island, Ill., and Fort Worth, Tex., 913 miles, with wayside offices at Rock Island, Ill.; Kansas City, Mo.; Herington, Kan.; El Reno, Okla.; and Fort Worth, Tex. Also on the Rock Island, one locomotive and one caboose, used in through freight service between Rock Island and Kansas City, 336 miles, as well as between Rock Island and Omaha, Neb., 329 miles, are equipped with end-to-end communication apparatus using Klystrom micro-wave equipment made by the Sperry Gyroscope Company.

Radio warning signal.

On December 18, the Bendix Radio Division of the Bendix Aviation Corporation announced a new radio device to send a warning to approaching trains when any train has been stopped under unusual circumstances. The device is intended as an adjunct on sections of railroad in which radio train communication is being installed on the locomotives used on road trains.

The proposal is that each locomotive be equiped with apparatus so that if the train makes an unusual stop, the engineman can operate a push-button which causes a device to broadcast a special high-frequency slow-tone in the form of a series of high-pitched tones, that will be received as a warning to enginemen in the locomotives of other trains within a range of four to five miles. The device is not intended to replace any safety equipment or practice now in use on railroads, but rather to supplement existing measures.

Yard communication.

Facilities for telephone conversation between yard locomotives and offices in yards or terminals are known as yard communication systems, whereas the term train communication is applied to road trains. A brief history is that in 1941 the Louisville & Nashville installed the Union Switch & Signal Company inductive yard communication system in a yard at DeCoursey, Ky, and since that time the same system has been installed and is in regular service in about 15 other yards on various roads including the Pennsylvania, the Burlington, the Great Northern, the Norfolk & Western, the Big Four and the Terminal Railroad Association of St. Louis.

During 1945 the Baltimore & Ohio installed radio communication in a yard at New Castle, Pa., using Bendix radio apparatus to equip three yard locomotives and one fixed station, the equipment being furnished bq the Bendix Radio Division of the Bendix Aviation Corporation. Also the Burlington made an installation of Bendix radio apparatus in the terminal at Chicago including seven Diesel-electric switch locomotives and three yard offices. Early in 1946 this project is to be expanded to equip 18 additional locomotives.

At Corwith yard in Chicago, the Santa Fe is conducting tests of Bendix radio apparatus including three locomotives and one yard office. Also at this yard the Santa Fe recently made a test of the advantages of frequency modulation as compared with amplitude modulation, using radio apparatus furnished by the Farnsworth Television & Radio Corporation. No definite conclusions are as yet available. Starting on December 3, the Reading began conducting tests of radio apparatus made by the Maguire Industries, Inc.

In 1945 the New York Central installed radio communication in Selkirk yard near Albany, N. Y., consisting of four mobile units and one fixed station, this apparatus being furnished by the General Railway Signal Company. Radio equipment also furnished by the General Railway Signal Company will be installed early in 1946 in two yards near Syracuse, N. Y., and one yard near Buffalo, N. Y. Each of these projects includes four mobile units and one fixed station. Also in 1945 the New York Central had a test installation of radio in service at Weehawken, N. J. This test included apparatus on one locomotive and one wayside office, the equipment being furnished by the Halstead Company now part of the Farnsworth Television and Radio Corporation.

On the Denver & Rio Grande Western authority has been issued to install radio communication in the yard at Denver including seven Diesel switching locomotives and two yard offices.

During 1945 the Canadian National installed radio telephone communication equipment on ten locomotives and in two yard offices in the Longue Pointe yards at Montreal, Que. This was furnished by the Canadian Marconi Company.

In a large freight yard at Blue Island, Ill., near Chicago, the Rock Island installed Motorola radio telephone communication apparatus on four yard locomotives and in the yardmaster's office.

Sound systems.

In order to classify the types of apparatus, the term sound system has been applied to projects in which fixed microphones in offices or elevated shanties are connected to amplifiers with wire circuits to loud-speakers at various locations in yards where they can be heard by conductors and switchmen as well as by enginemen on yard locomotives. Microphones at certain locations in the yard are used for talking back to the office or to loud-speakers in other sections of the yard.

During recent years several large yards have been equipped with these so-called sound systems. For example, in 1945 the Denver & Rio Grande Westhern installed, in a yard at Grand Junction, Colo., a two-way communication system including 12 outlying speakers and 2 paging speakers, operated from a control console, by means of which it is possible to communicate with personnel at several locations throughout the yard. The loud-speakers were furnished by the Webster Electric Company and the amplifiers by the Radio Corporation of America.

Another similar communication and paging system is now being installed in the Roper yard near Salt Lake City with the control consoles in two 45-ft. towers each of which commands a good view of the portion of the yard assigned to it. In this project the speakers are being furnished by Webster and R.C.A., the amplifiers by the Electronics Communication Equipment Company, and the rectifiers by the Raytheon Manufacturing Company.

Somewhat similar sound equipment, designated as announcing systems, has been installed during the past several years in numerous passenger stations and train sheds as well as in freight depots. In some of the new streamlined trains, loud-speakers in the various passenger cars will be connected to a microphone in the conductor's « office » by means of which the stations can be called, and other announcement made to passengers.

F. C. C. on use of radio.

A brief history of the early use of radio for train communication is that the railroads made numerous tests during the past 25 years but in the range of frequencies used before the war there were none available for permanent assignment to the railroads. In recent years, especially during the war, many developments were made in the use of high-frequency apparatus so that many more channels are available. Accordingly in September, 1944, the Federal Communications Commission held extended hearings to receive evidence from the railroads and the manufacturers concerning the uses for train communication, especially with reference to the need for assignment of radio frequencies for this service. On January 16, 1945, the Federal Communications Commission issued a report proposing an allocation of frequencies for various services including that on railroads. After further hearings, definite assignments of frequencies were made on May 17. In order to simplify the assignments of frequencies, the various railroads have cooperated through a committee of the Communication Section of the Association of American Railroads in applying to the Federal Communications Commission for assignments of frequencies to the different carriers.

A further doubtful factor was cleared up on August 21, when the F. C. C. issued an order stating in effect that railroad employees using radio telephone equipment on locomotives and cars or in wayside offices need not be required to hold operator's licenses.

Then on November 15, the Federal Communications Commission issued its rules and regulations governing railroad

radio service which deals in detail with the apparatus, tests, inspections and methods of operation. The Commission also announced that it is considering the possibility of relaxing the present low power rules which govern the railroad carrier-current communication systems, otherwise known as inductive systems.

A summary of the various actions by the Federal Communications Commission during 1945 is that the railroads were given about all they might reasonably expect, and the general opinion is that the railroads can now proceed to utilize radio train communication with assurance. The item concerning the raising of the low power limit for inductive systems is also of importance to roads planning to use this type of equipment.

Discord from I. C. C.

Back in 1937 a law was enacted giving the Interstate Commerce Commission jurisdiction of... block signal system, interlocking, automatic train stop, train control, and/or cab signal devices and/or other similar appliances, methods and systems intended to promote the safety of railroads operation,... Under this law the railroads are required to make applications to the I. C. C. for permission to make changes in facilities named in the law as quoted above.

When the Atlantic Coast Line decided to install train communication on approximately 234 miles between Rocky Mount, N. C., and Florence, S. C., via Wilmington, an application was made to the Interstate Commerce Commission for permission to make the installation. On February 19, the I. C. C. issued two orders, one authorizing the A. C. L. to install the train communication, and the second one ordered the railroad to show cause why it should not be required to install block signaling on not only the 202 miles of single track in the proposed train communication territory, which had no signaling, but also on approximately 1 848 miles of other portions of the A. C. L., on some of which there was only one passenger train scheduled daily as well as on 63 miles between Florence, N. C., and Wadesboro where there was no scheduled passenger service. According to the best information available, no hearings have been called or other action taken on this matter.

The Missouri Pacific applied to the Interstate Commerce Commission for permission to install train communication, and as of November 9, this Commission issued two orders, one authorizing the train communication project, and the second ordering the railroad to show cause why a signal system should not be installed on 72.9 miles of line which is the part of the proposed train communication territory that is not now equipped with automatic block signaling.

May halt some installations.

Although the I. C. C. thus accepted and acted upon applications concerning train communication, Senator Wheeler, on November 1, introduced bill S. 1537 proposing a law to the effect that the Interstate Commerce Commission be given jurisdiction of not only train communication but also other railroad telegraph and telephone facilities.

This question of whether the Federal Communications Commission or the Interstate Commerce Commission is to have jurisdiction over the installation and operation of train communication is confusing to some railroads, and may cause hesitancy in proceeding with proposed installations.

MISCELLANEOUS INFORMATION.

[**621.** 138.2 (.44)]

Mechanical stoking for locomotive fireboxes,

by H. LEDARD,

Engineer, Technical Organisation Department, French National Railways.

(Traction Nouvelle.)

Mechanical stoking for locomotive fireboxes has long been tried by the American Railways, and their first trials with this device date from about 1900. After 1922 the application of mechanical stoking became more and more numerous, whilst improvements in design produced a reduction in maintenace costs, which at the present time are quite insignificant. The number of mechanical stokers in service in the U. S. A. and Canada is about 20 000, and it is largely due to their use that the American Railways have been able, during recent years, to increase considerably the annual mileage of their locomotives.

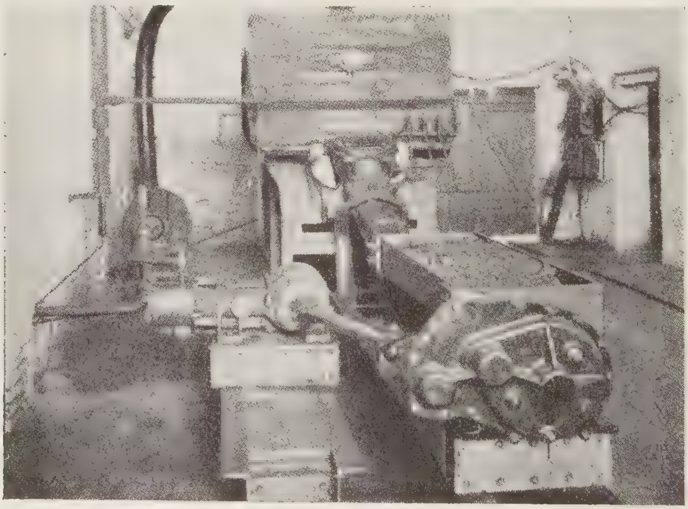
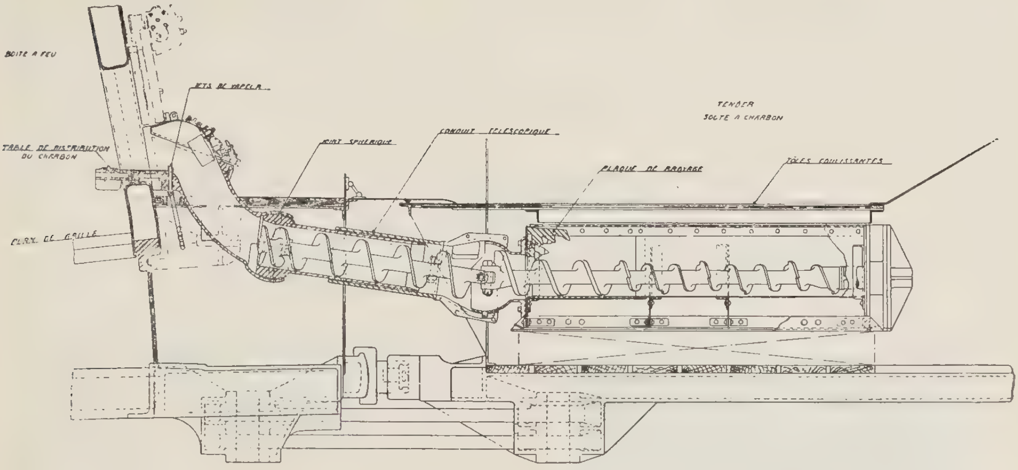


Fig. 1. — Bench trial of BK type stoker.

The ease of fire control provided by mechanical stoking, the rapidity with which the grate can be cleaned, as well as the improvements in lubrication methods, have in fact made possible *the equipment of several engines to permit very long journeys of 800 to 1 000 km. (500 to 620 miles) without change of engine.*

Station stops, for changing of crew and cleaning of firebox, which took place at intervals of 400 to 500 km. (250



STOKER TYPE B K

Fig. 2. — Diagram of BK type stoker.

Explanation of French terms:

Boîte à feu = firebox. — Table de distribution = coal distributing table. — Plan de grille = plan of grate. — Jets de vapeur = steam jets. — Joint sphérique = ball joint. — Conduit télescopique = telescopic tube. — Plaque de broyage = breaker plate. — Tender soute à charbon = coal bunker. — Tôles coulissantes = sliding plates.

to 310 miles) are now in the region of five to ten minutes.

The large stock reduction which can be realised owing to the reduced number of locomotives required for operation, to the reduction in the size of intermediate depots situated between two large centres, and to the more rapid amortisation of the engine by reason of the increased monthly mileage (15 000 to 20 000 km. or 9 300 to 12 400 miles) attracted the attention of the Engineers of the Rolling Stock Department of the French Railways. Following an investigation in America, the former Nord and Etat systems decided in 1930 to carry out trials with mecanical firing, using apparatus provided by the « Société Stein », under license from the Standard Stoker Company.

A « Nord » *Pacific* with 4.27 m² (46 sq. ft.) grate (1931), then two *Decapod*

Fig. 3. — *Decapod* locomotive (Nord region) fitted with BK type stoker drawing heavy mineral train.

engines with long, narrow 3.5 m² (37.67 sq. ft) grates (1933) were successfully fitted with a BK type stoker, and as satisfactory results were obtained, it was decided to extend the fitting to 30 *Decapod* engines (51201—51230) and to try the same device on a *Pacific* locomotive of the 31251-90 class, having 3.5 m² (37.67 sq. ft.) grate. At the same time an « Etat » *Mountain* class engine, with a 5 m² grate (53.82 sq. ft.) was equipped with a MB type stoker.

Fig. 4. — Interior view of the engine cab of locomotive, figure 3.

The photograph and diagram reproduced here show the BK type stoker, which has given the best results. Hopper type ashpans provide a uniform supply of air under a special grate of the Hulson tube type.

The coal, projected by steam jets, is spread in a very thin layer (only a few centimetres thick) according to the steam requirements, and is in process of combustion before reaching the grate. The fire door remains constantly closed, and the fireman has only to regulate the speed of the operating motor according to the rate of combustion. The quantity of fuel supplied being always in good proportion to the blast, the smoke combustion is excellent, and steam losses through the safety valves are practically eliminated.

The fireman, released from the arduous task of shovel stoking, is able to work over very long runs without fatigue, devoting full attention to the signals.

The use of expensive fuels, such as screened coal and briquettes, becomes pointless. *Coal with a high content of volatile matter gives the best results, and contrary to experience with shovel stoking it is not necessary to provide fuels of cokefying quality.* The latter factor possesses an obvious national advantage, the total French production of coking coal being insufficient for metallurgical needs. The great regularity of the firing and the combustion contribute to the good behaviour of the fireboxes.

The mechanical stoker of simple and robust type which is particularly well adapted for use with the normal type of steam locomotive, constitutes one of the latest improvements in the modern steam locomotive, successfully contributing to the evolution of this method of traction.

The S. N. C. F., taking care to give the French Railway system all the benefits of technical progress, decided before the war to fit 50 new *Decapod* locomotives designed for freight train working with a HT type stoker (improved BK type) as well as the first engines of new classes in construction or in design at the time, in particular eight 2-3-2 engines with 5.25 m² (56.98 sq. ft.) grates, three of which were three-cylinder simple-expansion engines, four were four-cylinder compounds, and one a Ljungström turbine locomotive.

[385. (09.2]

OBITUARY.

Edmond FOULON,

Honorary Civil Engineer.
Former President of the Permanent Commission of the International Railway Congress Association.
Honorary General Manager of the Belgian National Railways.

We deeply regret to record the death on the 6th July 1944 of Mr. Edmond FOULON, Honorary Civil Engineer, Honorary General Manager of the Belgian National Railways and former President of the Permanent Commission of our Association.

Mr. Edmond Foulon was born in Roux on the 19th February 1868. Having done well at College, he went to the School of Civil Engineering attached to the University of Ghent and became Honorary Civil Engineer in 1891. On the 4th January 1892, a Royal Decree made him Civil Engineer, attached to the Railway Construction Department where, at first, he distinguished himself by the planning and the construction of the great metallic bridge over the Meuse at Anseremme.

On the 1st January 1895, he was transferred to the Administration of the Belgian State Railways with the abovenamed Department.

At the time, the Belgian Railways were in full development and Mr. Foulon took the greatest part in the works of extension in progress.

He was put in charge on the 22nd September 1919 of the Department of Research and Works, as Chief Engineer, Director of Administration.

His brilliant career brought him to the notice of the Administration and on the 16th July 1921, he became Director of the Way and Works Department. Therefore, he had in hand the heavy task of the restoration of the whole railway network after the war, as well as the improvement of various lines and stations, which at the time were not suitable for the rational working of the railway system.

In 1924, Mr. Foulon became Director General and in 1926 when the Belgian National Railways Company was formed the Board of Administration of same appointed him General Manager.

In this position, Mr. Foulon promoted and worked out great reforms such as : improvement of the working methods; modernization of the machinery and tools of the repair workshops and rational organisation of labours methods; reequipment and reorganisation of the permanent way workshops; methodical and continual maintenance of the tracks. Thanks to these reforms, the Belgian National Railways were able to face the crisis of 1930 and fight advantageously the competition of the other means of transport.

Mr. Edmond Foulon retired on the 28th February 1933 after a career of more than 41 years.

Mr. Foulon was appointed member of the Permanent Commission of the International Railway Congress Association at the closing Meeting of the Rome Session in 1922. Already in 1910 he had

attended the Berne Session as delegate of the Belgian Government and of the Administration of the Belgian Railways.

On the 28th February 1925, he was elected unanimously President of the Permanent Commission of our Association to replace Mr. Tondelier who had resigned.

He presided with great talent the works of the London (1925), Madrid (1930), and Cairo (1933) Sessions. In the management of the Association's business and in the position of President of the Permanent Commission or of its Executive Committee, Mr. Foulon spared no pains. His great qualities of tact and honesty as well as his great kindness and his charming modesty earned him the high esteem and the admiration of all those who came in contact with him.

Mr. Foulon resigned his office of President of our Association in July 1933, unanimously regretted by his Colleagues of the Permanent Commission.

The highest Belgian and foreign honours were bestowed on Mr. Foulon in the course of his brilliant career. He was made a Grand Officer of the « Ordre de la Couronne » and the « Ordre de Léopold II » and Commander of the « Ordre de Léopold ». He also held such high honours as Grand Officer of the « Ordre du Nil », Grand Commander of the « Ordre Royal d'Isabelle la Catholique », Commander of the « Ordre de la Légion d'Honneur », the Order of Civil Merit of Spain, the Order of « Polonia Restituta », the Military Order of Christ of Portugal and the Grand-Ducal Order of the « Couronne de Chêne du Luxembourg ».

His native town gave his name to one of its streets to honour his memory.

We wish to convey our heartfelt sympathy to Madame Edmond Foulon and Family.

The Executive Committee.

Edmond FOULON

Lord ROCKLEY, P.C., G.B.E.,

Former Director of the Southern Railway,
Former Member of the Executive Committee of the Permanent Commission of the International Railway Congress Association.

At the end of the hostilities we have learned with deep regret the death on April 1st, 1941, of our former and much devoted Colleague, the Right Hon. Lord ROCKLEY, P. C., G. B. E., eminent member of the Permanent Commission of the International Railway Congress Association.

Lord Rockley was a son of Lord Eustace Cecil and had been a Member of Parliament continuously for 31 years up to 1929, when he retired. He began his political career in 1891 as Assistant Private Secretary to his uncle, Lord Salisbury, the Prime Minister, and as Evelyn Cecil took his seat in Parliament for the first time in 1898, making history on the occasion, being the first candidate to use a motor car in electionneering. Lord Rockley was raised to the peerage in 1934.

In 1902, Lord Rockley (then Sir Evelyn Cecil) joined the Board of the former London and South Western Railway Company and upon grouping, continued as a Director of the Southern Railway Company from which he retired in December 1940. Lord Rockley was also a member of the Southern Railway Company's Traffic Committee (of which he acted as Chairman) and the Engineering, Estate and Rating Committee. He was also a supernumerary member of the Company's Finance Committee, and was a representative on the Great Western and Southern Railways Joint Committee, the Somerset and Dorset Joint Committee and the West London Extension Railway Company (of which he was Chairman).

Lord Rockley was one of the most ancient members of the Permanent Commission of our Association having been appointed in 1906. He took already part in the works of the Washington (1905) Session as delegate of the London and South Western Railway Company. He was elected a member of the Executive Committee in 1920 and actively participated in our works. He regularly attended the meetings of the Permanent Commission and of its Executive Committee. His great affability and his business abilities were much

appreciated and he was always pleased to help in any circumstances.

He attended the Berne (1910) and Rome (1922) Sessions. He was Vice-President of the Local Organising Committee at the London Session in 1925. He took also an active part in the Madrid (1930), Cairo (1933) and Paris (1937) Sessions as well as at the enlarged meetings of the Permanent Commission held at Brussels in 1935 and 1939.

The death of Lord Rockley occurred only three months after his retirement from the Board of Directors of the Southern Railway Company.

His charm, courtesy and willingness to listen to explanation will not be forgotten by all those who knew him and particularly by his Colleagues who held him in high esteem.

We will keep the best memory of our much regretted Colleague.

The Executive Committee.

Frédéric BRUNEEL,

Honorary Civil Engineer.
Honorary « Administrateur-President » of the Belgian State Railways.
Former Vice-President of the Permanent Commission of the International Railway Congress Association.
Reporter of the Paris (1889) and St. Petersburg (1892) Sessions.

On the 23rd June 1942 died one of the most eminent personalities of the Belgian Railways and a devoted friend of our Association, Mr. Frederic BRUNEEL, Honorary Civil Engineer, « Administrateur-Président » of the Belgian State Railways, former Vice- President of the Permanent Commission of our Association.

Mr. Frederic Bruneel was born in Renaix on the 20th October 1855. He studied brilliantly first at the local secondary school of his native town and after at the Royal Athenæum of Tournai. Then in 1872, he was admitted at the School of Civil Engineering attached to the University of Ghent, where he obtained the degree of Honorary Civil Engineer. He first assisted his father in architectural works and on the 30th June 1878 he entered as Assistant Engineer in the Departement of Way and Works of the Administration of the Belgian State Railways.

He began to work in the Division of Brussels-North and then, during a short time, in the Division of Tournai. After, Mr. Bruneel was put in charge of the important Section of Antwerp (South) which included all the railways' installations of the Port of Antwerp.

Various works of extension of the Port were at the time in progress and the construction of new railway lines to connect these installations as well as the new railway sorting station South of Antwerp were added to the ordinary duties of the important department managed by the young Engineer Bruneel.

However, for health reasons, he had, six years later, to come back to Brussels as First Engineer, assistant of the Engineer in chief, Director of the Department of Way and Works at Brussels-North.

On the 30th April 1897 Mr. Bruneel

was promoted Chief Engineer, Director of Department, and put in charge of the « Service Spécial de Construction des gares de Bruxelles » which built the station of « Tour & Taxis » as first important job. Then he had in hand the first studies regarding the « Junction North-South » of which he was the promoter. He became Director of Administration on the 30th December 1910 and was called to the Central Administration in 1912 as « Administrateur ». He managed the Department of the Permanent Way in 1919 and was nominated « Administrateur-Président » of the Belgian State Railways the 11th July 1921.

He retired on the 31st December 1925 after a long and brilliant career of 47 years and a half.

The master-work of the career of Frederic Bruneel is the construction of a railway line between the stations of Brussels-North and Brussels-South, with a central halt in the heart of the city. The execution of the scheme, which bears the name of its author was approved by the Belgian Parliament already in 1901. However the realisation of this vast scheme met with numerous difficulties and was delayed owing to the wars of 1914-1918 and 1939-1945. But Mr. Bruneel, who never ceased to defend his idea had the supreme satisfaction to see, at the end of his life, the realisation of his plans on the way to completion.

The town of Renaix called one of its streets, « Frederic Bruneel » in memory of this great Engineer.

Mr. Bruneel had been appointed Member of the Permanent Commission of our Association in 1920 and Vice-President of the Permanent Commission in April 1922.

His share in the works of the International Railway Congress Association dates from the Paris (1889) Session where he was reporter of the question II, litt. A. « Comparison of bull-headed rails and Vignoles rails ». At the St. Petersburg (1892) session, he reported on question III « Permanent Ways' maintenance ». He was also delegate of the Belgian Government at the London (1895) and Washington (1905) Sessions. At the latter, he was First Secretary of Section I (Way and Works).

He attended also the Rome Session (1922) where he presided the works of Section I.

Mr. Bruneel relinquished his positions of member and Vice-President of the Permanent Commission of our Association in February 1925.

The highest Belgian and foreign honours were bestowed on Mr. Bruneel during his brilliant career. He was Grand Officer of the « Ordre de la Couronne de Belgique » and Commander of the « Ordre de Léopold ». He also held such high honours as Grand Officer of the « Ordre de la Couronne d'Italie » and Commander with plate (Grand Officer) of the Order of Charles III of Spain.

We wish to convey our sincerest sympathy to his family.

The Executive Committee.

Antoine SCHRAFL, Dr. h. c.

Former President of the Swiss Federal Railways.
Former Director of the Central Office of International Railway Transport.
Former Member of the Permanent Commission of the International Railway Congress Association.

On the 3rd January 1945 passed away, at the age of 72, Mr. Antoine SCHRAFL, Dr. h. c., former President of the General Management of the Swiss Federal Railways and ancient devoted collaborator of our Association.

Mr. Antoine Schrafl was born in 1873. After ending his classical schooling in 1892, he won the diploma of Civil Engineer at the Federal Polytechnical School in 1896. The same year, he was put in charge of the Department of Public Works at Zurich; then, in 1898, he directed the construction of the Reichenau-Ilans line of the Rhaetian Railway. In 1902, he took the position of assistant Engineer in Chief of the St. Gothard Railway at Lucerne. In 1909 when the Company was bought back, he became assistant Chief Engineer of the Vth Division of the Swiss Federal Railways, and in 1917, Vice-President of same. In 1922, he was appointed General Director of the Swiss Federal Railways, Chief of the Department : Working and Construction. Then in 1926 he was nominated President of the General Direction of the Swiss Federal Railways, Chief of the Department of Finance and Personnel. He held this eminent position till 1938 when he was selected as Director of the Central Office of International Railway Transport in Bern.

He retired from this position on the 30th June 1943.

The name of Mr. Schrafl will remain attached to two considerable works : the electrification of the Swiss Railways network and the reform of the Administration and Working.

Mr. Schrafl, had the great merit of accelerating the electrification of the Swiss Railway System and thanks to his extraordinary energy and to his hability he succeeded in overrunning all oppositions and difficulties in his way.

Another big task done by Mr. Schrafl was the simplification and the rationali-

sation of the Administration, a very delicate and complicated job which required wide measures of reorganisation.

A third problem in which he was greatly interested was the intricated question of sharing the traffic. Expert in commercial matters, Mr. Schrafl sought by all means to create an understanding between the Railways and the Road.

It is due to his great hability in railways matters that Mr. Schrafl was appointed on the 1st March 1938, Director of the Central Office of International Railway Transport, after having retired from his position of President of the General Direction of the Swiss Federal Railways. He kept his new appointment until the 30th June 1943; therefore his activity developed for a great part during war-time. Man with a large experience and of conciliatory spirit, he directed the International Office with a ferm and calm manner through all the difficulties born from the conflict. This was partly due in fact to the good relationship he was maintaining with eminent foreign personalities and to the influence he had outside his own country.

Mr. Schrafl was elected in 1927 a member of the Permanent Commission of the International Railway Congress Association. He took part in the Madrid (1930) and Paris (1937) Sessions and in spite of his many activities he always proved himself a faithful and devoted collaborator, attending also regularly the periodical meetings of our Commission. He resigned his appointment in 1938.

We wish to convey our sincerest sympathy to his family.

The Executive Committee.

NEW BOOKS AND PUBLICATIONS.

[**625.** 14 (02]

LAMALLE (U.), Ingénieur civil des Mines, A. I. Lg., Honorary General Manager of the Belgian National Railways Company, Professor of the University of Louvain. — **Cours d'exploitation des chemins de fer,** *Tome III :* **La Voie.** *(Railway operating course, Vol. III. The Permanent Way).* One volume (7 7/8 × 10 ½ inches) of 228 pages with 303 figures. — 1942, Louvain : Librairie Universitaire Ch. Uystpruyst, 10, rue de la Monnaie, et Paris : Librairie Dunod, 92, rue Bonaparte. Publishers (Price : 140 Belg. francs).

This author has already given us, in the framework of an university course, « Commercial operating » forming Volume I and « Technical operating » forming Volume II. The former is an extensive work dealing with the subject from every point of view : commercial, technical, administrative, financial and economic. The second volume covers signalling and contains details relating to the most up-to-date methods, the automatic block, light signals, cab signals (repeating the signals in the driver's cab).

A special volume, reviewed in the April 1938 issue of this *Bulletin,* deals with *Laying track on curves.* Although it preceeded the present book, it should be taken as a part or supplement to it.

In Volume III, the author deals with the superstructure of the track, and with each of its three components in turn : the ballast, the sleepers, and the rails. A fourth part covers the question of track equipment, which heading includes all the devices used wherever vehicles have to pass from one line to another of change their direction.

The notes on the ballast describe the various materials used, their respective qualities, and the conditions under which they are used. A graph of the prices over 14 years shows the wide variations which occur, and the changes in practice due to the state of the market. In many other parts of the book economic considerations and facts are reported which builders and operators would do well to take into account. A paragraph on weed-killing should be pointed out, as it stresses the up-to-date methods of permanent way maintenance.

As regards sleepers, the author describes the part they play and the stresses to which they are subjected, and shows the relation between the section used and the process of sawing up the timber. Impregnation of the sleepers includes an examination of the action of chemical products, the methods used, and their influence on the cost price and the life of the sleeper.

One important point which attracted the attention of the author is the fixing of the rail and method of laying it on the sleepers. The question of rail fastenings comes under discussion in connection with metal or concrete sleepers where they are of the utmost importance. Much information is given about these two competitors of the wood sleeper : their precise form, the circumstances which justify their use (climate, weight, price, life, availability).

In the case of rails, the following problems are dealt with : choice of section, calculating the section, quality of the metal, wear, and life, form of joints. The latter point is connected with the length of rails, a subject on which opinions and practice have considerably changed. Wear is affected by the chemical composition, the use of special

steels, and appropriate heat treatment, of which the author gives a description based on scientific considerations. This part ends with an examination of the methods used to prevent rail creep.

Track equipment includes above all points and crossings. The reader will find here all the necessary geometrical studies required in connection with the design of turnouts and junctions, with right or left hand points, with rigid or spring blades, together with information concerning the influence of the angle, both in junction and crossings, with the conditions under which they should be used. The information is completed by details of the most characteristic layouts.

The study of points and crossings naturally leads to that of the working of points and safety devices at crossings. Safety of working depends on the arrangement as a whole. Important installations have been laid out in this field in recent years and very noteworthy progress made. The author deals very concisely, with the assistance of very clear drawings, with wire or rod operating, and power operating (nowadays always electrical), and the safety devices, both mechanical and electrical, which now make it possible for trains to run through facing points at speed without danger .

In the final chapter, the author deals with the apparatus and equipment which enable vehicles to be turned or moved parallel to themselves : tunrtables for wagons and coaches, transporters, turntables and turning triangles for locomotives. In each case the details of the installation and construction which are of the greatest interest to railway operators are given.

Together with « *Laying track on curves* » this work forms a very complete and substantial whole, in which the didactic spirit is uppermost. It will give the engineering student the main ideas and principal facts he requires without risk of leading him astray, while for the professional engineer it will form a precious guide which can usefully be consulted both in the ordinary course of work and when some special problem arises.

[**621**. 13 (02, **625**. 25 (02 & **625**. 28 (02]

LAMALLE (U.), Ingénieur civil des Mines, A. I. Lg., Honorary General Manager of the Belgian National Railways Company. Professor of the University of Louvain. — **Cours d'exploitation des chemins de fer**, *Tome IV*. **Traction et freinage**. *(Railway Operating course. Vol. IV. Traction and braking)*. — One volume (7 7/8 × 10 ½ inches) of 214 pages with 201 figures and tables. — 1944, Louvain : Librairie Universitaire, Ch. Uystpruyst, 10, rue de la Monnaie, et Paris : Dunod, rue Bonaparte, 92. Publishers (Price : 180 Belg. francs).

Mr. Lamalle is an author well known to readers of the *Railway Congress Bulletin*. In addition to articles on various subjects in connection with railway operating, he has drawn up several reports on questions on the agenda of the Rome, London and Madrid Sessions of the Congress.

In another sphere of activity, teaching, he has published several works, the first and most extensive of which « Commercial operating » is in its third edition. The others, which have appeared in several parts, deal with *technical operating* and the *permanent way*.

Continuing the series of his educational works, the author has just published a further volume, Volume IV, under the title : « *Traction and braking* ».

In dealing in a limited space with

such a vast field embracing such a multitude of machines and mechanical and electrical apparatus, the orientation of the subject is of particular importance. The author has dealt chiefly with the theoretical side of the question, as the reader who wants facts and detailed descriptions can find these in other works, in particular, in the case of locomotives, in another book published by the author in collaboration, called « *The locomotive, an analytical description of its mechanism* ».

The question « *Traction* » is divided into two parts, the first dealing with the « *Steam Locomotive* », and the second with « *Other Methods of traction* ».

The plan followed in the first part is to collect together all the essentials for successfully designing a steam locomotive. It includes a full report of the knowledge required regarding train resistance, the theory of the working of the engine and a study of the phenomena which centre around the boiler, with its indispensable adjunct the draught. There is then a discussion of the best methods of determining the leading dimensions of a locomotive. To appreciate fully the value of the design and judge of the performance of the engine, *tests* can then be carried out and various *measurements* be taken, the technique of which is dealt with in the two chapters which terminate this first part of the work.

Among the *other methods of traction*, the author deals with rail cars, electric traction, and special types of locomotives.

In what is in fact a second volume, *Braking*, the author gives us a detailed study of the working and special properties of compressed air and vacuum brakes, and a theory of braking which brings out the natural laws as shown by fairly old trials and more recent experiments, laws which must be taken into account when designing a good brake.

Though completed in 1944, this work has been brought up-to-date very thoroughly. For example, the chapter dealing with the exhaust includes the results of recent investigations from which Belgian locomotives have greatly benefited. The question of rail cars and electric traction is illustrated by examples from current practice in Belgium and other countries, as well as designs planned for use in the near future. Mention may also be made, without exhausting the list, of continuous brakes on goods trains, which has given rise to much discussion and come up against great difficulties.

Amongst practical examples which the author considers worthy of mention, it is pleasant to find many descriptions of ideas put forward by Belgian engineers, such as the inertia ergmeter, the double exhaust, and a culculating machine for working out the train timetables.

This short note cannot pretend to give a complete analysis of the work. It can only give some idea of the lines on which it is planned and the wealth of information it contains.

The book includes many illustrations, curves showing various laws or diagrams of rolling stock, which with the numerical tables and information of all sorts taken from the most reliable sources, make it an invaluable work of reference. Though educational in purpose, it has far exceeded this object. The amount of concrete ideas and positive information it contains will make it an invaluable work of reference for all railway engineers.

MONTHLY BIBLIOGRAPHY OF RAILWAYS (1)

PUBLISHED UNDER THE SUPERVISION OF

P. GHILAIN,

General Secretary of the Permanent Commission of the International Railway Congress Association.

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)16. 385. (02]

I. — BOOKS.

In French.

5 — **62. (01**

ANDREAU (E.).

blèmes de résistance des matériaux, avec leurs solu-

is, Albin Michel, éditeur. 1 volume (16.5 × 25 cm.) 4 pages, avec 670 figures. (Prix : 410 fr. français.)

4 — **691**

RY (J.).

béton. Influence de ses constituants inertes. Règles oter pour sa meilleure composition. Sa confection et ansport sur les chantiers.

is (6e), Dunod, éditeur, 92, rue Bonaparte. 1 vol. 21 cm.), de VI-196 pages, avec 37 figures. 2e édit.

3 — **691 & 721 .9**

STIER (V.).

ul et exécution des ouvrages en béton armé. III : Ponts. Murs de soutènement. Barrages. 2e édit.

is, Dunod, éditeur, 92, rue Bonaparte. 1 volume 25 cm.) de IV-226 pages, avec 116 figures.

1 — **62. (01 & 721 .9**

RIN (A.).

théories nouvelles de la flexion dans les pièces en armé.

is, Dunod, éditeur. 1 volume de 454 pages, avec gures et 28 tableaux.

1 — **669. (02**

LET (L.).

métaux légers et leurs alliages (aluminium, magné- glucinium, métaux alcalins et alcalino-terreux). **II : Alliages : constitution, propriétés ; emploi des x et de leurs alliages.**

is (6e), Dunod, éditeur. 2 volumes (16 × 25 cm.), enant ensemble LX-492 pages, avec 681 figures.

4 — **691 (.493) & 721 .9 (.493)**

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xelles, Rapport no 15 de l'Association Belge de ardisation, rue Ducale, 63. Une brochure français- nd de deux fois (X + 63) pages, format A 4 30 cm.) avec, pour chaque langue, 9 figures et leaux, dont 2 hors-texte. (Prix : 70 fr. belges.)

1942 — **691**

MAGNEL (G.).

Pratique du calcul du béton armé. (4e partie.)

Gand, Rombaut-Fecheyr, place d'Armes, 1. 1 volume broché (16 × 24.5 cm.) de 252 pages, avec de nombreuses figures dans le texte et 9 planches hors-texte.

1942 — **624. (06**

Mémoires de l'Association Internationale des Ponts et Charpentes. Sixième volume : 1940/41.

Zurich, édité par le Secrétariat général de l'Association. 1 volume in-8o, VIII-306 pages et 165 figures dans le texte.

1942 — **656**

PIROU (G.).

Les transports. Les chemins de fer. La navigation intérieure. Les transports automobiles. L'aviation commerciale. Les transports maritimes. La coordination des divers moyens de transports.

Paris, Dunod, 92, rue Bonaparte. 1 vol. de 324 pages

1944 — **625 .42 (.44) & 656 .256 .3 (.44)**

PORNIN (R.).

La signalisation du Chemin de fer Métropolitain de Paris.

Paris, L. Eyrolles, éditeur. 1 volume in-8o (250 × 165) de 355 pages, avec 141 figures.

1945 — **621 .9**

SALMON (P.).

Machines-outils. Réception. Vérification. (2e édition.)

Paris, Henri François, éditeur, 47, avenue Philippe-Auguste. 1 album (24 × 31 cm.), de 172 pages illustrées. (Prix : 350 fr. français.)

In English.

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Railway Block Telegraph Regulations.

Kirkintilloch (near Glasgow) : S. B. A., « Glenesk », Northbank Avenue. 1 volume (4 3/4 × 7 in.), 206 pages, illustrated. (Price : 3 sh. 6 d.)

(1) The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress con- with the Office Bibliographique International, of Brussels. (See « Bibliographical Decimal Classification as applied to Railway », by L. Weissenbruch, in the number for November 1897, of the *Bulletin of the International Railway Congress*, p. 1509).

1940 62 (01 (06 (.73)

AMERICAN SOCIETY FOR TESTING MATERIALS.

A. S. T. M. Standards, including Tentative Standards, 1939. 3 vol. (6 × 9 inches), illustrated, with diagrams, charts and tables. Vol. I: Metals, 1.308 pages; Vol. II: Non-metallic, Constructional, 1.217 pages; Vol. III: Non-metallic, General, 1.175 pages.

1939-1940. Published by the A. S. T. M., Philadelphia, Pa. (Price, clothbound: any one part, $ 8; any two parts, $ 15; all three parts, $ 22.)

1941 656 .256 .3 (.73)

ASSOCIATION OF AMERICAN RAILROADS (A. A. R.), SIGNAL SECTION.

American Railway Signaling Principles and Practices. Chapter VI: **Direct current relays.** (Revised December 1941.)

New York, N. Y., published by the Signal Section, A. A. R., 30, Vesey Street. 1 pamphlet (6 × 9 inches), 34 pages, illustrated. (Price: 25 cents; for members A. A. R. and railroad employees: 15 cents.)

1940 656 .25 (0 (.73)

ASSOCIATION OF AMERICAN RAILROADS (A. A. R.), SIGNAL SECTION.

American Railway Signaling Principles and Practices. Chapter XIV: **Definitions.** (Revised 1940.)

New York, N. Y., published by the Signal Section, A. A. R., 30, Vesey Street. 1 pamphlet (6 × 9 inches), 102 pages. (Price: 35 cents; for members A. A. R., and railroad employees: 25 cents.)

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ASSOCIATION OF AMERICAN RAILROADS (A. A. R.), SIGNAL SECTION.

American Railway Signaling Principles and Practices. Chapter XX: **Interlocking circuits.** (Revised edition, 1941.)

New York, N. Y., published by the Signal Section, A. A. R., 30, Vesey Street. 1 pamphlet (6 × 9 inches), 164 pages & fig. (Price: 45 cents; for members A. A. R. and railroad employees: 35 cents.)

1942 656 .256 .2 (.73)

ASSOCIATION OF AMERICAN RAILROADS (A. A. R.), SIGNAL SECTION.

American Railway Signaling Principles and Practices. Chapter XXII: **Manual block system and rules governing opposing and following movement of trains by block signals. Fundamental theory of direct current.** (Revised edition, March 1942.)

New York, N. Y., published by the Signal Section, A. A. R., 30, Vesey Street. 1 pamphlet (6 × 9 inches), 54 pages & fig. (Price: 30 cents; 20 cents for members A. A. R. and railroad employees.)

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1941 **385.** 62 & **385.**
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1941 **625.** 1 (.4
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ILLET (L.). — Les **aciers inoxydables.** (5 200 mots)

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SSIER (H.). — Le développement cyclique du **armé.** (10 500 mots & fig.)

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Civil, nº 3025-3026, 1-8 février, p. 52.

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41 662

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ULASSOL (J.). — Les erreurs du calcul des **es à treillis en béton armé.** (3 200 mots & fig.)

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RKLEN (J.) & VALLOT (E.). — Substitution essive et conditionnelle de l'**acier** au fer. (1 600

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RSONNIN. — Le **chauffage des trains remorqués quement.** (13 000 mots & fig.)

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1 625. 252 (.44)

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BASTIEN. — **Renforcement d'un pont à poutres continues** au moyen d'arcs métalliques supérieurs. Pont sur la Siagne (ligne de Marseille à Vintimille). (5 000 mots & fig.)

1941 621. 335 (.44) & 625. 212 (.44)

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TOURNEUR. — La **Micheline électrique.** (4 500 mots, 2 tableaux & fig.)

1941 656 (.44)

Revue générale des chemins de fer, nº 3, mai-juin, p. 171.

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GOLLETY & SOULAT. — La **gare** de Marseille-Canet. (2 500 mots & fig.)

1941 625. 617 (.44)

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1941 625. 211 (.44) & 625. 231 (.44)

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1941 656. 223

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PLOUVIEZ. — Le **rendement du matériel à marchandises** en temps de guerre. (3 600 mots & 1 tableau.)

1941 625. 214

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LE FUSTEC. — La **régénération des huiles** de moteurs thermiques à la S. N. C. F. (4 000 mots, 1 tableau & fig.)

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1941 629. 113. 4 (.493) & 662 (.493)

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LEGRAYE. — Les **carburants** nationaux dans la traction automobile. (2 100 mots & fig.)

1941 **621. 435**
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BAILLY (R.). — Les **gazogènes.** (3 000 mots.)

1941 **629. 113. 4 & 662**
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GILLET (A.). — Le **combustible pour gazogène.** (6 000 mots, 2 tableaux & fig.)

1941 **621. 431 & 662**
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LAUMONT (G.). — Fonctionnement des **véhicules à gaz comprimé.** (3 500 mots, 2 tableaux & fig.)

1941 **621. 433 (.493) & 662 (.493)**
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de BROUWER (L.). — La distribution du **gaz comprimé** en Belgique. (2 700 mots & 1 carte.)

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RESTIEAU (L.). — **Gaz comprimé** pour la traction automobile. (7 000 mots, tableaux & fig.)

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1940 343 .346 (.43)
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KITTEL (Th.). — **Gefährdungshaftung und Verschuldenshaftung.** (9 000 Wörter & 1 Tabelle.)

1940 385 .1 (.73)
Archiv für Eisenbahnwesen, Juli/August, S. 577.
GUTSCHE (H.). — Die **Gliederung der Erfolgsrechnung** bei den Nordamerikanischen Eisenbahnen. (12 000 Wörter & Tabellen.)

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von RENESSE. — Die **Nationale Gesellschaft der belgischen Eisenbahnen** in den Jahren 1937 und 1938. (6 000 Wörter & Tabellen.)

1940 385 .113 (.52)
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WERNEKKE. — Die **Besteuerung** der amerikanischen Eisenbahnen. (3 000 Wörter.)

1940 **656**
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SIEPERT. — Neuzeitliche Planungsgrundsätze
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PROPP. — Der **Schienenstoss.** (9 000 Wörter &

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STACH. — Erfahrungen mit **Stahlfeuerbüchsen**
Gelenkstehbolzen. (2 700 Wörter & Abb.)

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BEILFUSS. — Das Wichtigste über die **Hartm**
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1940 **621. 135. 2 &**
Der Bahn-Ingenieur, Nr. 24, 16. Juni, S. 308.
HESSE. — Bearbeiten der **Radreifenumrisse** be
Lokomotiv-Treib-und Kuppelradsätzen mit Hart
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1940 **621. 33 (**
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TEICHTMEISTER (J.). — Der **elektrische Zugb**
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BECKER (K.). — Beitrag zur vereinfachten **B**
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Querverteilungszahlen bei verschiedenen Trägheitsm
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THER (H.). — Verlauf und Ausnutzung des **Haft-s zwischen Rad und Schiene** bei elektrischen Trieb-eugen. (2 500 Wörter, 1 Tafel & Abb.)

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TTONI (T.) & MARTINELLI (M.). — Die **Schnell-vagen** der Italienischen Staatsbahnen für 3 000 Volt nstrom. (1 000 Wörter.)

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HÜTER (G.). — Die Übertragung waagerechter Kräfte durch **kugelförmige Drehpfannen.** (2 400 Wörter.)

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HÖNIG (K.). — Die **fünfteiligen 1950-PS-Diesel-Triebwagenzüge** der Niederländischen Eisenbahnen. (3 500 Wörter, 2 Tabellen & Abb.)

1940 **656. 211. 5 & 656. 212. 6**
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1940 **621. 135. 3 (.43) & 625. 213 (.43)**
Glasers Annalen, Heft 19, 1. Oktober, S. 198.
LUTTEROTH (F.). — Neuzeitliche **Tragfederbearbeitung** bei der Deutschen Reichsbahn und ihre Voraussetzungen. (7 000 Wörter, 1 Zahlentafel & Abb.)

Gleistechnik und Fahrbahnbau. (Karlsruhe.)

1940 **625 .144.3**
Gleistechnik und Fahrbahnbau, Heft Nr. 15/16, 15. August, S. 57.
FINDEIS (R.). — Der **Übergangsbogen.** (2 000 Wörter & Abb.)

1940 **625 .142.2 (.43)**
Gleistechnik und Fahrbahnbau, Heft Nr. 15/16, 15. August, S. 61.
WERNEKKE. — Zusammengesetzte **Holzschwellen.** (1 600 Wörter & Abb.)

1940 **625 .113**
Gleistechnik und Fahrbahnbau, Heft Nr. 17/18, 15. September, S. 65.
JIRA (F.). — Das **Krümmungsbild** als Grundlage der Linienverbesserung. (3 500 Wörter & Abb.)

1940 **656** .212.5 & **656** .257
Gleistechnik und Fahrbahnbau, Heft Nr. 19/20, 15. Oktober, S. 77.
AHLGRIMM (H.). — Das Ablauftischhebelwerk Bauart VES und die selbsttätige Weichenstellung im **Ablaufbetrieb.** (3 200 Wörter & Abb.)

1940 **625** .17 (.73)
Gleistechnik und Fahrbahnbau, Heft Nr. 19/20, 15. Oktober, S. 83.
Die **Unterhaltung des Oberbaus** bei den Eisenbahnen der Vereinigten Staaten. (1 000 Wörter.)

1940 **625** .151
Gleistechnik und Fahrbahnbau, Heft Nr. 23/24, 15. Dezember, S. 97.
PISTOLKORS (E. v.). — Zur Berechnung von **Weichen- und Gleisanlagen.** (2 000 Wörter & Abb.)

1941 **625** .143.4
Gleistechnik und Fahrbahnbau, Heft Nr. 1/2, 15. Januar, S. 1.
HAAS (M.). — **Schienenstoss** auf Rahmenschwelle. (1 100 Wörter & Abb.)

1941 **625** .143 (.45)
Gleistechnik und Fahrbahnbau, Heft Nr. 1/2, 15. Januar, S. 5.
Die **Schienen** der Italienischen Staatsbahnen. (2 500 Wörter.)

1941 **625** .122
Gleistechnik und Fahrbahnbau, Heft Nr. 3/4, 15. Februar, S. 9.
JELINEK (R.). — Zur Frage des **Böschungswinkels von Böden.** (2 800 Wörter & Abb.)

Grossdeutscher Verkehr. (Berlin.)

1941 **625** .13 (.43)
Grossdeutscher Verkehr, Heft 10, Mai, S. 276.
DOLL (F.). — Probleme beim Bau von **Autobahntunnels.** (6 500 Wörter & Abb.)

1941 **621** .131.2 & **621** .335
Grossdeutscher Verkehr, Heft 11/12, Juni, S. 324.
FLEMMING (F.). — Die **Form der Lokomotive** in ihrer technisch bedingten Entwicklung. (3 500 Wörter & Abb.)

1941 **621** .431 .72 (.43)
Grossdeutscher Verkehr, Heft 11/12, Juni, S. 331.
TASCHINGER (O.). — Die schönheitstechnische Gestaltung der **Reichsbahntriebwagen.** (3 500 Wörter & Abb.)

1941 **625** .23
Grossdeutscher Verkehr, Heft 11/12, Juni, S. 339.
WIENS. — **Formgebung der Personenwagen.** (4 500 Wörter & Abb.)

Die Lokomotive. (Bielefeld-Berlin.)

1940 **621** .
Die Lokomotive, Nr. 6, Juni, S. 81.
ROOSEN (R.). — Neue **Henschel-Kondens-Loko ven.** (1 400 Wörter, Tafeln & Abb.)

1940 **621** .
Die Lokomotive, Nr. 7, Juli, S. 93.
SCHÖNING (P. und F.-W.). — **2B1-h1-Schnell Tender-Lokomotive.** (Einzylinder-Lokomotive.) (Wörter & Abb.)

1940 **621** .
Die Lokomotive, Nr. 7, Juli, S. 99.
LEIPERT (A.). — Messstand und Messgeräte **Nachmessen von Lokomotiv-Radsätzen.** (1 900 W & Abb.)

1940 **621** .
Die Lokomotive, Nr. 7, Juli, S. 103.
Dr. METZELTIN. — Zur **Stehbolzenfrage.** (1 100 ter.)

1940 **621** .118 (.73) & **656** .284
Die Lokomotive, Nr. 7, Juli, S. 105.
Schwere Amerikanische **Kesselexplosion.** (900 Wö

1940 **621** .13
Die Lokomotive, Nr. 8, August, S. 111.
RITTER (Dr. P.). — Graphische **Ermittlung Gegengewichte.** (1 100 Wörter & Abb.)

1940 **621**
Die Lokomotive, Nr. 8, August, S. 113.
Rollende Lagerung für hin- und hergehende Bew gen bei Triebwerken und Steuerungen. (600 W & Abb.)

1940 **621**
Die Lokomotive, Nr. 8, August, S. 117.
MEINEKE (F.). — Neue **Blasrohrform.** (250 W & Abb.)

Organ für die Fortschritte des Eisenbahnw (Berlin.)

1940
Organ für die Fortschritte des Eisenbahnwesens, H 1. Juni, S. 179.
STUMPP (Th.). — Aufgaben der **Verdunk** (1 200 Wörter & Abb.)

1940 **621** .4
Organ für die Fortschritte des Eisenbahnwesens, H 15. Juni, S. 185.
CORBELLINI (G.) und DIEGOLI (M.). — B mung der kennzeichnenden **Betriebskoeffizienten Triebwagen mit Verbrennungsmotoren.** (1 800 W 1 Tabelle & Abb.)

940 **621 .136.1**

an für die Fortschritte des Eisenbahnwesens, Heft 12, 15. Juni, S. 190.

FENNINGS. — Die **Lastabbremsung der Schlepp-ler.** (1 700 Wörter & Abb.)

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940 **621 .131.1**

an für die Fortschritte des Eisenbahnwesens, Heft 12, 15. Juni, S. 194.

etriebsmessfahrten mit **Dampflokomotiven.** (900 Wör-)

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940 **625 .173 (.439)**

an für die Fortschritte des Eisenbahnwesens, Heft 13, 1. Juli, S. 199.

ÖRÖK (Koloman). — **Neuere Werkzeuge** und **Gleis-erhaltungsmaschinen** bei den Königl. Ungarischen ıtseisenbahnen. (5 600 Wörter & Abb.)

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940 **385. (09.3 (.45)**

an für die Fortschritte des Eisenbahnwesens, Heft 13, 1. Juli, S. 206.

CHNEIDER (L.). — Zur italienischen **Eisenbahn-chichte.** (3 500 Wörter & 1 Karte.)

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940 **621 .131**

an für die Fortschritte des Eisenbahnwesens, Heft 13, 1. Juli, S. 210.

EINEKE (F.). — Uber den **Dampfverbrauch** der omotiven. (1 400 Wörter.)

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940 **625 .142.2 (.43), 691 (.43) & 694 (.43)**

an für die Fortschritte des Eisenbahnwesens, Heft 14, 15. Juli, S. 217.

RÖNER (Dr. Ing.). — Die **Holzwirtschaft** bei der ıtschen Reichsbahn. (12 000 Wörter, Tabellen & Abb.)

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940 **691 (.43)**

an für die Fortschritte des Eisenbahnwesens, Heft 14, 15. Juli, S. 232.

TUMPP (Th.). — Die Holzfaserhartplatte in der **ıaltungswirtschaft** der Reichsbahn-Aussbesserungs-ke. (1 500 Wörter & Abb.)

Die Reichsbahn. (Berlin.)

940 **385. (072 (.43)**

Reichsbahn, Heft 36/37, 4./11. September, S. 369.

IÜLLER (F.). — Das **Versuchswesen für Wärme-** ı **Energiewirtschaft** in den ortsfesten Anlagen der ıtschen Reichsbahn. (2 600 Wörter, Tabellen & Abb.)

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940 **621 .138.3 (.43)**

Reichsbahn, Heft 36/37, 4./11. September, S. 376.

)r. FRIEDRICH (K.). — Praktische Leistungsstei-ung im **Betriebsmaschinendienst.** (3 200 Wörter.)

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940 **656 .212.8 (.43)**

Reichsbahn, Heft 36/37, 4./11. September, S. 379.

)r. KLINKMÜLLER. — **Regulierprellbock-Richt-nd.** (1 600 Wörter & Abb.)

1940 **656 .212.5 (.43)**

Die Reichsbahn, Heft 38/39, 18./25. September, S. 389.

CONRADI (H.). — Die **architektonische Neugestaltung** des Bahnhofs Hohenstein (Ostpreussen). (2 000 Wörter & Abb.)

1940 **385.5 (.43)**

Die Reichsbahn, Heft 42, 16. Oktober, S. 435.

SCHUCHMANN. — Die **personalrechtlichen Verhältnisse** der elsässischen und lothringischen Eisenbahnen nach den bisherigen französischen Vorschriften. (5 300 Wörter.)

Zeitschrift des Vereines deutscher Ingenieure. (Berlin.)

1940 **621 .331**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 28, 13. Juli, S. 492.

KÖCHLING (W.). — **Wander- und Fahrzeug-Umspanner.** (3 200 Wörter & Abb.)

1940 **621 .392 & 624**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 30, 27. Juli, S. 538.

Schweissen von Brücken aus Baustahl St 52. (200 Wörter.)

1940 **621 .392 & 669**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 31, 3. August, S. 555.

von RAJAKOVICS (E.) & BLOHM (E.). — Einfluss der Oberflächenbeschaffenheit beim **Punktschweissen von Leichtmetallen.** (5 000 Wörter, 3 Zahlentafeln & Abb.)

1940 **625 .232 (.43)**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 31, 3. August, S. 563.

Leichtbau-D-Zug-Wagen. (400 Wörter & Abb.)

1940 **691 (.43)**

Zeitschrift des Vereines deutscher Ingenieure, Nr. 32, 10. August, S. 581.

HÖFINGHOFF (W.). — Erfahrungen der Deutschen Reichsbahn mit **Heimstoffen.** Nichtmetallische Werkstoffe. (5 000 Wörter & Abb.)

Zeitung des Vereins Mitteleuropäischer Eisenbahnverwaltungen. (Berlin.)

1940 **385 .113 (.43)**

Zeitung des Vereins mitteleur. Eisenbahnverw., Nr. 23, 6. Juni, S. 291.

PRANG. — Der **Jahresabschluss** 1939 der Deutschen Reichsbahn. (3 800 Wörter.)

1940 **621 (.43)**

Zeitung des Vereins mitteleur. Eisenbahnverw., Nr. 23, 6. Juni, S. 296.

LEHNER. — **Normung und Typisierung** bei der Deutschen Reichsbahn. (2 500 Wörter.)

1940 **385. (09 (.6)**

Zeitung des Vereins mitteleur. Eisenbahnverw., Nr. 24, 13. Juni, S. 303.

REMY. — Entwicklungstendenzen des **kolonialafrikanischen Eisenbahnbetriebes** nach dem Weltkrieg. (5 500 Wörter.)

1940 **385 .15 (.485)**

Zeitung des Vereins mitteleur. Eisenbahnverw., Nr. 25, 20. Juni, S. 315.

HEECKT (H.). — Die **Verstaatlichung** der Schwedischen Privatbahnen. (4 300 Wörter & 3 Tabellen.)

1940 **385. (09.3 (.45)**

Zeitung des Vereins mitteleur. Eisenbahnverw., Nr. 26, 27. Juni, S. 325.

TOSTI (L.). — Zum **hundertjährigen Bestehen** der Italienischen Bahnen. (4 800 Wörter & Abb.)

1940 **656 .235.4 (.73)**

Zeitung des Vereins mitteleur. Eisenbahnverw., Nr. 27, 4. Juli, S. 337.

Dr. MOORMANN. — **Seehafentarifpolitik** in U. S. A. (4 800 Wörter & 1 Karte.)

1940 **385. (09 (.725)**

Zeitung des Vereins mitteleur. Eisenbahnverw., Nr. 29, 18. Juli, S. 361.

WERNEKKE. — Die **Eisenbahnen** von Mexiko. (5 000 Wörter & 1 Karte.)

1940 **385 .1 (.43)**

Zeitung des Vereins mitteleur. Eisenbahnverw., Nr. 30, 25. Juli, S. 373.

Dr. BUSCH. — Grundzüge der **Finanzpolitik** der Deutschen Reichsbahn. (9 000 Wörter.)

1940 **385. (09.3 (.47)**

Zeitung des Vereins mitteleur. Eisenbahnverw., Nr. 32, 8. August, S. 401.

Dr. WEHDE-TEXTOR. — Die **Verkehrsverhältnisse** Russlands beim Beginn des Eisenbahnbaus und ihre Entwicklung in 100 Jahren. (2 200 Wörter.)

Zeitschrift für das gesamte Eisenbahn-Sicherungs- und Fernmeldewesen. (Berlin.)

1941 **656 .253 (.43)**

Zeitschr. für das ges. Eisenb.-Sicherungs- und Fernmeldewesen, Nr. 3, 20. Februar, S. 19.

GLÄSEL & KRACKE. — **Signalbauzüge.** (2 000 Wörter & Abb.)

1941 **656 .254 (.43)**

Zeitschr. für das ges. Eisenb.-Sicherungs- und Fernmeldewesen, Nr. 5, 10. April, S. 35.

Zusammenstellung der im Jahre 1940 bei der Deutschen Reichsbahn im **Fernmeldewesen** eingeführten Neuerungen und durchgeführten Versuche. (2 000 Wörter.)

1941 **656**

Zeitschr. für das ges. Eisenb.-Sicherungs- und Fernme wesen, Nr. 5, 10. April, S. 37; Nr. 7/8, 10. J S. 57.

HENNIG (K.). — Übertragungssysteme im **Fernme wesen.** (7 000 Wörter, 2 Zahlentafeln & Abb.)

1941 **656 .25 (.4**

Zeitschr. für das ges. Eisenb.-Sicherungs- und Fernme wesen, Nr. 7/8, 10. Juni, S. 51; Nr. 9, 10. J S. 65; Nr. 10/11, 20. August, S. 73; Nr. 10. Oktober, S. 90.

SASSE (H. W.). — Das belgische **Signalwe** (10 000 Wörter & Abb.)

1941/42 **656 .254 (**

Zeitschr. für das ges. Eisenb.-Sicherungs- und Fernme wesen, Nr. 10/11, 20. August, S. 69; Nr. 12, 10. tember, S. 80; Nr. 14/15, 20. November, S. Nr. 1, 10. Januar, S. 4; Nr. 2/3, 20. Februar, S. Nr. 5, 10. April, S. 31; Nr. 9, 10. Juli, S. 59.

LEONHARD (E.). — Die **selbsttätigen Warnlich lagen** der Deutschen Reichsbahn. (18 000 Wörter & A

1941 **656**

Zeitschr. für das ges. Eisenb.-Sicherungs- und Fernme wesen, Nr. 13, 10. Oktober, S. 87; Nr. 14 20. November, S. 100.

CAMRATH. — Einige Vorschläge zur **Sicherung Zugfahrten auf gemischtspurigen Gleisen.** (4 500 Wö & Abb.)

1941 **656 .2**

Zeitschr. für das ges. Eisenb.-Sicherungs- und Fernme wesen, Nr. 16, 10. Dezember, S. 105.

STREIDT (H.). — Die Unterhaltung der **Fahrkar druckmaschinen.** (2 500 Wörter & Abb.)

In English.

Bulletin, American Railway Engineering Association. (Chicago.)

1940 **613 (.73) & 725 .33 (**

Bulletin Amer. Railway Engineering Assoc., Decem p. 95.

Report of Committee 13. Water service, Fire pro tion and sanitation. Pitting and corrosion of locomo boiler tubes and sheets; embrittlement investigat Cathodic protection for prevention of corrosion of s tanks. Effects of lubricating oil in boilers and meth for correction. Removal of silica from boiler feed wa etc. (2 000 words & fig.)

1940 **656 .21 (.**

Bulletin Amer. Railway Engineering Assoc., Decem p. 107.

Report of Committee 14. **Yards and terminals.** minal facilities: for various later types of rolling sto for servicing electrical and air conditioning equipm in passenger cars. Scales and weighbridges. Term facilities: for the care of diesel locomotive equipme for the washing of passenger cars mechanically; handling highway trucks and trailers on and off rail cars. Bibliography on subjects pertaining to yards terminals appearing in current periodicals (1930/19 etc. (18 000 words & fig.)

0 385 (071 (.73)

in Amer. Railway Engineering Assoc., December, 155.

ort of Committee 24. **Cooperative relations with rsities:** causes of instruction; technical education; ch work; assigning men of adequate ability, expe- and fitness for giving instruction in transportation conomics, etc. (9 000 words.)

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0 625 .144.4 (.73) & 625 .17 (.73)

in Amer. Railway Engineering Assoc., December, 173.

ort of Committee 27. **Maintenance of way work ient.** Standardization of parts for railway main- e motor cars. Devices for applying metal preser- s to rail and fastenings. Methods of keeping data ork equipment (forms). Pneumatic-tired tractor ient. Impact wrenches. Arc welding equipment. ck grading equipment. (6 500 words & fig.)

) 385 .587 (.73) & 625 .17 (.73)

n Amer. Railway Engineering Assoc., December, 213.

ort of Committee 22. **Economics of railway labor.** sis of operations of railways that have made l progress in the reduction of maintenance labor. e economy of combined vs. separate bridge and g gangs. Labor economics resulting: from impro- ainage practices; from the use of off-track main- e equipment, etc. (6 000 words & fig.)

) 69 (.73) & 725.3 (.73)

n Amer. Railway Engineering Assoc., December, 225.

ort of Committee 6. **Buildings.** Garage buildings. ls of determining the protective value of paints. words & fig.)

Engineer. (London.)

5 625 .13 (.42)

er, No. 4687, November 9, p. 369.

I. S.-G. W. R. Cheltenham and Gloucester **track ng.** (1 200 words & fig.)

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5 656 .212.7 (.42)

er, No. 4687, November 9, p. 375.

ley Street **goods shed,** Birmingham. (1 800 words

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5 621 .133.1 (.42)

er, No. 4688, November 16, p. 388.

urning **locomotives** of the G. W. R. (1 800 words

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5 627 .82 (.73)

er, No. 4689, November 23, p. 408; No. 4690, vember 30, p. 430.

rson Ranch **dam.** (3 000 words & fig.)

1945 **656 .254 (.42)**

Engineer, No. 4689, November 23, p. 422.

L. M. S. **traffic control** improvements. (900 words & fig.)

Engineering News-Record. (New York.)

1940 **624 (0 (.73) & 624 .32 (.73)**

Engineering News-Record, August 29, p. 42.

WYLY (L. T.), FULLENWIDER (T. I.) and MURPHY (R. B.). — **Adjustment of continuous bridge** (Illinois River) affected by warping. (1 700 words & fig.)

1940 **624 (.73)**

Engineering News-Record, August 29, p. 46.

Bridging the Pennsylvania Turnpike (307 grade separation and drainage structures on 160-miles). (3 400 words & fig.)

1940 **625 .13 (.73)**

Engineering News-Record, August 29, p. 50.

Driving 85 miles of **tunnel** (Delaware Aqueduct VI). (New ideas in drilling and blasting procedure, drill carriage, car changers, and invert clean-up. Record standards of speed, efficiency and safety.) (3 900 words & fig.)

1940 **624.7 (.73)**

Engineering News-Record, September 12, p. 72.

GROVE (William G.). — One-leg bents or towers support open steel grid deck of **viaduct** over Housatomi River. (2 100 words & fig.)

1940 **624.3 (.73)**

Engineering News-Record, September 12, p. 78.

SHEPPARD (K. A.). — Traveler speeds arch viaduct forms **concrete arch construction** in the approach system of the George Washington bridge. (1 500 words & fig.)

1940 **621.7 (.73) & 698 (.73)**

Engineering News-Record, September 26, p. 53.

DECK (E. W.). — Flame cleaning for preparing structural steel for **painting.** Description of method, typical examples with estimates of labor and material involved. (1 700 words & fig.)

1940 **625 .13 (.73)**

Engineering News-Record, September 26, p. 61.

Tunnel haulage and hoisting (85-mile Delaware Aqueduct VII). (2 600 words & fig.)

1940 **625 .42 (.73)**

Engineering News-Record, September 26, p. 64.

Underpinning beats **subway** threat to famous old 17-story Monadnock office building, carried on floating foundations that are being underpinned with caissons. (2 800 words & fig.)

1940 69 (.73) & 725.4 (.73)
Engineering News-Record, October 10, p. 48.
HYLER (Loiell). — Frameless **welded cellular construction** of sheet metal for shop at Peoria. (1 000 words & fig.)

1940 624 .52 (.73)
Engineering News-Record, October 10, p. 54.
Columbia River **bridge** raised 45 ft. (cantilever sections raised on jacks as supporting piers were being built up.) (1 100 words & fig.)

1940 625 .13 (.73)
Engineering News-Record, October 10, p. 56.
HUNT (John J.) and WERNER (Bernard L.). — Building Baltimore's big (pressure water) **tunnel.** (4 000 words & fig.)

1940 627 (.73) & 721.1 (.73)
Engineering News-Record, October 10, p. 70.
LYNN (A. V.) and RHOADES (Roger F.). — **Foundation** exploration at Kentucky Dam. (3 000 words & fig.)

Journal, Institute of Transport. (London.)

1942 656 .2 (.42)
Journal, Institute of Transport, January, p. 379.
KLAPPER (Ch. F.). — Some post-war **operating problems.** (2 000 words.)

1942 388 (.42)
Journal, Institute of Transport, April, p. 423.
ANSELL (W. H.). — Post-war **planning and transport.** (1 500 words.)

1942 385. (09 (.43)
Journal, Institute of Transport, April, p. 428.
WHITWORTH (C. E.). — The **German Railway** in peace and war: an analytical study. (5 500 words, tables & fig.)

1942 385. (06.1 (.42)
Journal, Institute of Transport, April, p. 441.
STANBRA (J. E. T.). — The **Railway Clearing House,** 1842-1942. (1 500 words & fig.)

1942 656 (.42)
Journal, Institute of Transport, July, p. 479.
NICHOLL (J. S.). — Future **transport problems.** (1 500 words.)

1942 656 (.42)
Journal, Institute of Transport, July, p. 482.
CRANE (H. C.). — **War transport** and the trader. (5 500 words.)

1942 385
Journal, Institute of Transport, October, p. 530.
BONAVIA (M. R.). — Theory and practice in **railway administration.** (2 500 words.)

1943
Journal, Institute of Transport, April, p. 590.
SMITH (F.). — Communications. The key to **eco**
order. (1 500 words.)

1943 656 .212
Journal, Institute of Transport, April, p. 593.
CASTLEMAN (A. L.). — Railway **goods te**
operations in London during war-time. (2 000 word

1943 656 .234
Journal, Institute of Transport, July, p. 617.
VALENTINE (A. B. B.). — **Passenger fares:**
mics or Tradition? (3 000 words.)

Modern Transport. (London.)

1945 621 .132.6
Modern Transport, June 23, p. 11.
New standard L. N. E. R. **tank locomotive.** Im
coal and water supplies. (1 000 words & fig.)

1945 656 .1
Modern Transport, June 23, p. 16.
JORDAN (C. E.). — Traders and **road tra**
Future scope of C Licenses. (2 000 words.)

1945 621 .132.6
Modern Transport, June 30, p. 5.
Modified L. M. S. **tank locomotives.** New se
2-6-4 type. (Shortened coupled wheelbase.) (800
& fig.)

1945 656 .211.5
Modern Transport, June 30, p. 14.
Novel **railway ticket issuing machine:** The Bell
on the L. N. E. R. (5 000 words & fig.)

1945 625 .232
Modern Transport, June 30, p. 15.
Modern U. S. Railway **coaching stock.** (1 000
& fig.)

1945 625 .232 (.42) & 621 .39
Modern Transport, June 30, p. 17.
New L. M. S. R. **coaches.** Use of welded
(500 words & fig.)

1945 656 .28
Modern Transport, July 7, p. 13.
Stop and proceed **collision.** Ballymacarrett
accident. (1 400 words.)

1945 656 .25
Modern Transport, July 14, p. 17.
Radio for train crews. Driver-guard commun
(800 words & fig.)

1945 656 .28
Modern Transport, July 21, p. 5.
Running-back **derailment.** Gas Works Tunnel a
L. N. E. R. (2 400 words.)

45 **621 .132.3 (.42)**
rn Transport, July 21, p. 9.
ht **Pacifics** on Southern Railway. The Bulleid West
try Class. (1 500 words & fig.)

45 **385 .113 (.4)**
rn Transport, July 28, p. 5.
lian Railways. Railway Board 1943-1944 **report.**
0 words.)

Proceedings, American Society of Civil Engineers. (New York.)

41 **624 .52**
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. 517.
RDSALL (Blair). — The **suspension bridge tower**
lever problem. (4 500 words & fig.)

41 **625 .13 (.73) & 625 .42 (.73)**
eedings, Amer. Soc. Civil Engineers, April 1941,
. 617.
LD (Jacob). — **Tunnel construction,** Sixth Avenue
ay, New York, N. Y. (9 000 words, tables & fig.)

roceedings, Institution of Railway Signal Engineers. (Reading.)

41 **621 .35 & 656 .25**
edings, Institution of Railway Signal Engineers,
941, p. 73.
LIOTT (T. C.). — **Accumulators** and their ailments.
) words.)

41 **656 .251 (.485)**
edings, Institution of Railway Signal Engineers,
941, p. 90.
SCELLES (T. S.). — **Signalling** on the Swedish
rays. (3 200 words & fig.)

43 **656 .25**
edings, Institution of Railway Signal Engineers,
943, p. 24.
velopment in **electric cables.** (4 000 words.)

43 **656 .25 (.68)**
edings, Institution of Railway Signal Engineers,
943, p. 37.
ARKEY (S.). — The history and development of
lling on the Railways of South Africa. (13 000 words
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43 **656 .251 (.42) & 656 .283 (.42)**
edings, Institution of Railway Signal Engineers,
943, p. 103.
SCELLES (T. S.). — The origin of the **centrally**
ced semaphore. The accident at Abbots Ripton on
reat Northern Railway. (2 000 words & fig.)

1944 **656 .25**
Proceedings, Institution of Railway Signal Engineers, 1944, p. 24.
KAY (W.). — Petroleum products used in **railway signalling.** (6 000 words.)

1944 **656 .256**
Proceedings, Institution of Railway Signal Engineers, 1944, p. 39.
COLEY (J. P.) & MacGREGOR (R. M.). — Coded **track circuits:** their theory and application. (13 000 words & fig.)

1944 **656 .254 (.42)**
Proceedings, Institution of Railway Signal Engineers, 1944, p. 65.
THOMSON (W.). — **Carrier telephone systems** and their application to British Railway trunk line communications. (9 000 words & fig.)

Railway Age. (New York.)

1940 **625. 244 (.73)**
Railway Age, August 24, p. 275.
Interesting construction used in 40-ton plywood **refrigerator cars.** About 6 000 lb. weight saving. Dead air space largely used for insulation. (2 500 words, tables & fig.)

1940 **625. 122 (.73) & 693 (.73)**
Railway Age, August 24, p. 281.
Cantilever type concrete retaining walls supported partly on old walls and partly on piles (Erie RR.) (3 500 words & fig.)

1940 **385 & 659**
Railway Age, August 31, p. 307.
DONOVAN Jr. (Frank). — The **railroad in literature** as a public relations medium. Railroads figure large in story and song, much of which could be used for public relations. (1 500 words & bibliography of books mentioned.)

1940 **625 .215 (.73)**
Railway Age, September 21, p. 390.
Truck requirements for high-speed freight service. (Extracts from reports of A. A. R. tests set forth general lines on which development must proceed.) (3 200 words & fig.)

1940 **656 .254 (06 (.73)**
Railway Age, September 21, p. 394.
Telegraph and Telephone Section meets in Ottawa. (Reports describe efficient utilization of railroad communication facilities to meet emergency requirements.) (3 400 words.)

1940 **347 .763 (.73) & 351 .81 (.73)**
Railway Age, September 21, p. 399.
S. 2009 (Wheeler-Lea **omnibus transportation bill**) signed by President. Act also adds a new Part III to regulate water carriers. (4 300 words & fig.)

1940 **625 .1 (06 (.73)**
Railway Age, September 21, p. 404, and September 28, p. 440.
Roadmasters hold largest Convention since 1929, discussing : Slow orders ; Welding — its uses in track ; Maintenance of gage under today's higher speeds ; Tie renewal ; The effect of weight of rail on track maintenance ; Simplification of track work ; Handling snow and ice ; Ditching and bank widening. (8 000 words & fig.)

1940 **625 .232 (.73)**
Railway Age, September 28, p. 432.
Pressed Steel Car Co. shows de luxe **passenger coach** of light weight and high tensile steel construction. (1 400 words & fig.)

Railway Engineering and Maintenance. (Chicago.)

1940 **385 .52 (.73), 385 .56 (.73) & 625 .144.4 (.73)**
Railway Engineering and Maintenance, May, p. 311.
Higher wages — Fewer (maintenance of way) **men — More machines.** (A summary of a testimony before the Wage and Hour Division of the Department of Labor.) (8 400 words & fig.)

1940 **625 .144.4 (.73)**
Railway Engineering and Maintenance, May, p. 317.
Rail laying gang on the Rock Island relays 2 miles a day. (5 600 words & fig.)

1940 **625 .123 (.73)**
Railway Engineering and Maintenance, May, p. 321.
Subdrainage cures the sliding of high fill and permits Illinois Central to abandon 466 ft. of timber trestle as embankment becomes stable. (3 000 words & fig.)

1940 **624 .2 (.73) & 625 .13 (.73)**
Railway Engineering and Maintenance, May, p. 323.
BRODIE (Roy N.). — Stress computations for **bridge maintenance.** (2 400 words & fig.)

1940 **656 .259 (.73)**
Railway Engineering and Maintenance, June, p. 375.
Protective devices (employed to warn of rock falls, slides, bridge failures and fires in tunnels and snow sheds) increase safety of operation on the Southern Pacific. (7 000 words & fig.)

1940 **621 .392 (.73) & 725 .33 (.73)**
Railway Engineering and Maintenance, June, p. 379.
Arc welding used effectively to repair train shed. (4 000 words & fig.)

1940 **625 .144 (.73)**
Railway Engineering and Maintenance, June, p. 383.
MARTIN (J. B.). — Things to think about when **laying rail.** (4 500 words & fig.)

Railway Gazette. (London.)

1945
Railway Gazette, No. 16, October 19, p. 390.
Prevention of corrosion and corrosion fatigue. (2 words.)

1945 **656**
Railway Gazette, No. 16, October 19, p. 384.
European Inland Transport. (1 100 words & tab

1945 **624 .63 (**
Railway Gazette, No. 16, October 19, p. 392.
New **bridges** in Somerset, G. W. R. (1 100 w & fig.)

1945 **621 .132.8 (**
Railway Gazette, No. 16, October 19, p. 394.
New **Beyer-Garratt locomotives** for the Ceylon Go ment Railway. (2 000 words & fig.)

1945 **656**
Railway Gazette, No. 16, October 19, p. 403.
Provisional organisation for **European inland t port.** (900 words.)

1945 **621 .**
Railway Gazette, No. 17, October 26, p. 419.
DIAMOND (E. L.). — A classic **locomotive from research,** conducted by the Engineering Experiment tion of the University of Illinois. (900 words & fig

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1945 **621 .132.3 (.42) & 621 .134.1**
Railway Gazette, No. 18, November 2, p. 445.
CLAYTON (J.). — The « **Paget** » **locomotive.** I single-acting cylinders with rotary valves. An ap tion of the principles of the Willans central-valve e to the steam locomotive. (3 000 words & fig.)

1945 **625**
Railway Gazette, No. 18, November 2, p. 454.
Grouting soft spots in track. (600 words & fig.)

1945 **656 .211.7 (.485 +**
Railway Gazette, No. 18, November 2, p. 455.
New **train ferry** Malmö-Copenhagen route. (800 & fig.)

1945 **625 .232**
Railway Gazette, No. 18, November 2, p. 456.
United States **passenger coach designs.** (900 & fig.)

1945 **625 .23 (0**
Railway Gazette, No. 19, November 9, p. 479.
Standard carriage **seat dimensions** in the U. S (1 500 words & fig.)

1945 **625 .14**
Railway Gazette, No. 19, November 9, p. 480.
INGLIS (R. A.). — Comparative **stresses in ve and canted rails.** (2 000 words & fig.)

15 **621 .331 (.54)**
ay Gazette, No. 19, November 9, p. 483.
ervisory **substation control** on the G. I. P. R. words & fig.)

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15 **385 (.42)**
ay Gazette, No. 20, November 16, p. 501.
Alan Mount's **annual report.** (3 500 words & tables.)

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15 **385. (09 (.729)**
ay Gazette, No. 20, November 16, p. 508.
X (H. R.). — The **Jamaica railway,** 1845-1945. words & fig.)

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15 **656 .212.6**
ay Gazette, No. 20, November 16, p. 510.
YLE (T. W.). — Modern methods of **handling at railway stations.** (1 600 words.)

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15 **656 .212.5 (.73)**
ay Gazette, No. 20, November 16, p. 511.
modern American **marshalling yard.** (1 600 words)

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15 **656 .283 (.42)**
ay Gazette, No. 20, November 16, p. 519.
istry of War transport **accident report.** Manor Road ing, Grays, L. M. S. R.: June 14, 1945. (1 500 & fig.)

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15 **621 .138.3 (.42)**
ay Gazette, No. 21, November 23, p. 535.
posal of engines at motive-power depots. (1 200 & fig.)

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15 **656 .257 (.42)**
ay Gazette, No. 21, November 23, p. 543.
itution of Railway Signal Engineers. Discussion **nning, jointing and terminating cables.** (2 700 .)

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15 **656 .283 (.42)**
ay Gazette, No. 21, November 23, p. 546.
istry of War transport **accident report.** Ecclefe- L. M. S. R.: July 21, 1945. (2 700 words & fig.)

Railway Magazine. (London.)

15 **385. (09.3 (.729)**
ay Magazine, No. 560, November and December, . 313.
X (H. R.). — The **Jamaica Railway,** 1845-1945. words & fig.)

15/46 **621 .132.1 (.42)**
ay Magazine, No. 560, November and December, . 318; No. 561, January and February, p. 3.
SSERLEY (H. C.). — Random reflections on h **locomotive types.** (3 500 words & fig.)

1945/46 **621 .13 (.42)**
Railway Magazine, No. 560, November and December, p. 329; No. 561, January and February, p. 9.
ALLEN (C. J.). — British **locomotive practice and performance.** (3 500 words & fig.)

1945 **621 .132.3 (.42)**
Railway Magazine, No. 560, November and December, p. 342.
New G. W. R. **4-6-0 locomotive,** « 1000 » class. (800 words & fig.)

1946 **625 .232 (.42)**
Railway Magazine, No. 561, January and February, p. 31.
British Railways new **passenger coaches.** (600 words & fig.)

1946 **625 .14**
Railway Magazine, No. 561, January and February, p. 45.
JOHNSON (R. P.). — **Track and roadbed** for high-speed trains. (1 200 words.)

Railway Mechanical Engineer. (New York.)

1940 **621 .138 (06 (.73) & 621 .431 .72 (.73)**
Railway Mechanical Engineer, November, p. 432.
LOCOMOTIVE MAINTENANCE OFFICERS' ANNUAL MEETING (October 1940). — Abstracts of addresses, technical papers and discussions:
— Improving railroad service, by C. B. HITCH.
— Use of **machinery and tools in locomotive repairs,** by D. J. SHEEHAN.
— The **design, operation and maintenance of diesel-electric locomotives,** by H. V. GILL.
— Future **locomotive air-brake maintenance,** by J. P. STEWART.
— Locomotive maintenance for long runs, by Lee ROBINSON.
— The **responsibility of the locomotive maintenance officer,** and the federal inspector, by J. M. HALL.
— **Engine-house problems** of the present day, by H. E. HINDS. (20 000 words & fig.)

1940 **621 .133 (06 (.73) & 621 .138 (.73)**
Railway Mechanical Engineer, November, p. 450.
MASTER BOILER MAKERS' MEETING (22-25 October, 1940). — Abstracts of papers and discussion:
— Some problems of **boiler maintenance** (proper ratios; high capacity boiler), by A. G. TRUMBULL.
— **Oxy-acetylene and electric processes in boiler and tender work.**
— **Pitting and corrosion on firebox sheets** back of grate bearers.
— Means to improve **water circulation in the boiler.**
— **Treating boiler feedwater** chemically.
— Application of **iron, steel and alloy rivets in boiler work.**
— **Flues cracking through bead.** Tube and flue application.
— **Cinder cutting of firebox sheets, flues, tubes and smokeboxes.**
— **Maintenance of tender cisterns.** (25 000 words & fig.)

1940 **625 .2 (06 (.73) & 625 .26 (.73)**
Railway Mechanical Engineer, November, p. 472.

ANNUAL MEETING OF CAR OFFICERS' ASSOCIATION (22-25 October). — Abstracts of papers and discussion:
— **Shop operation. Electric welding.**
— **Lubricants and lubrication.**
— **Standard classification commodity cards.**
— **Freight car maintenance. Painting, etc.** (20 500 words & fig.)

1940 **621 .137 (06 (.73), 621 .431 .72 (.73) [& 662 (.73)**
Railway Mechanical Engineer, November, p. 487.

FOURTH ANNUAL MEETING OF THE RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION. — Abstracts of papers and discussion:
— Chief dispatcher's view on **fuel economy**, by T. O. WEEKS.
— **Utilization of locomotives** (greatest mileages covered).
— **Steam consumption of locomotive auxiliaries**, by E. E. CHAPMAN.
— The No. 8 E. T. **locomotive brake equipment** and its performance.
— Developments of **high-speed braking** (Budd brake, Decelostat, etc.).
— **Oil-burning firing practice.** A trip with the fireman. — What mechanical cleaning does to **fine coal.** — **Coal equivalents of oil fuels and power** (tables). — **Turbine and condensing locomotives** (research work). — Handling **coal fires in smoke restricted territory.** — **The road foreman and the diesel-electric locomotive.** (25 000 words, tables & fig.)

The Oil Engine. (London.)

1945 **621 .431**
The Oil Engine, No. 151, November, p. 173.

COLLACOTT (R. A.). — Combustion phenomena in **internal-combustion engines.** (2 000 words & fig.)

1945 **621 .431 .72 (.73)**
The Oil Engine, No. 152, December, p. 198.

MANN (Ch. F. A.). — Santa Fé rolling stock maintenance. Methods and equipment used in servicing the world's largest **oil-electric fleet.** (1 100 words & fig.)

1945 **621 .431 .72 (.73)**
The Oil Engine, No. 152, December, p. 220.

MANN (Ch. F. A.). — Operating the world's largest **oil-engined fleet.** (1 000 words & fig.)

In Spanish.

Boletin de la Asociacion Internacional Permanente del Congreso Sudamericano de Ferrocarriles. (Buenos-Aires.)

1941 **385 .113 (.82)**
Boletin de la Asoc. intern. perm. del Congreso Sudameric. de Ferrocarriles, Setiembre-Octubre, p. 90.

Resultados de explotacion de los Ferrocarriles Argentinos. Año financiero 1940-1941. (200 palabras & cuadros.)

1941/42 **625 .14 (01 & 656 .2**
Boletin de la Asoc. intern. perm. del Congreso Sudam de Ferrocarriles, Noviembre-Diciembre, p. 13; M Abril, p. 32; Mayo-Junio, p. 35.

ROMERO (H.). — La via ferrea y el alcance **grandes velocidades.** (26 000 palabras, cuadros & fig.

1941 **313 .385 (.44 + .73 +**
Boletin de la Asoc. intern. perm. del Congreso Sudam de Ferrocarriles, Noviembre-Diciembre, p. 56.

Comparacion de ciertos elementos estadisticos de Ferrocarriles de los Estados Unidos, Francia y la Ar tina. (2 000 palabras & cuadros.)

1942 **656 (**
Boletin de la Asoc. intern. perm. del Congreso Sudam de Ferrocarriles, Enero-Febrero, p. 13.

NONI (A.). — Los **medios de communicacion** e Republica Argentina. Problemas que afectan a los mos. (3 000 palabras.)

1942 **624 (0 (**
Boletin de la Asoc. intern. perm. del Congreso Sudam de Ferrocarriles, Enero-Febrero, p. 23; Marzo-A p. 11.

HASPERUE (L. A.). — Proyecto de nuevo reglam para el **calculo y prueba de los puentes metalicos** f viarios en la Republica Argentina. (9 000 pala cuadros & fig.)

1942 **625 .172 (.82) & 625 .245**
Boletin de la Asoc. intern. perm. del Congreso Sudam de Ferrocarriles, Marzo-Abril, p. 69.

GALOFRE (A. J.) & CAMANO (L.). — **En realizados con coche dinamometrico** en el ramal de B Blanca a Neuquen del Ferrocarril del Sud. (4 000 bras, cuadros & fig.)

Ferrocarriles y Tranvias. (Madrid.)

1940 **621 .132.3 (**
Ferrocarriles y Tranvias, Marzo, p. 74.

JUNOY (M.). — Las nuevas **locomotoras tipo** para la Compañia de M. Z. A. (3 200 palabras &

1940 **385 .4**
Ferrocarriles y Tranvias, Marzo, p. 79.

Regimenes ferroviarios vigentes en los princ países europeos. (10 000 palabras.)

1940 **385. (09 (**
Ferrocarriles y Tranvias, Marzo, p. 91.

Las **Companias de M. Z. A. y del Norte** duran guerra de liberación. (8 500 palabras.)

1940 **621 .43**
Ferrocarriles y Tranvias, Abril, p. 106.

SPIESS (R.). — **Mando automático por unidades tiples,** de automotores con transmisión mecánica. (palabras, tablas & fig.)

656 .224

ırriles y Tranvias, Abril, p. 120.
de LA FUENTE. — La **reserva de asientos en nos.** Mejora y simplificación de este servicio. palabras.)

656 .23

ırriles y Tranvias, Mayo, p. 138.
ONSO (Ed.). — Sobre **tarificación** ferroviaria. palabras & fig.)

656 (.460)

ırriles y Tranvias, Mayo, p. 150.
DERON y MONTERO-RIOS (E.). — Los trans- en España y su **coordinación.** (9 000 palabras

621 .33

ırriles y Tranvias, Junio, p. 170.
IO VIANI. — Conferencias sobre **tracción eléc-** 5 700 palabras & fig.)

Revista de Obras Públicas. (Madrid.)

656 .2 (.460)

de Obras Públicas, nº 2723, 1 de marzo, p. 105.
CIA-LOMAS (J. M.). — Los **transportes ferro-** en la hora actual. (6 000 palabras & graficos.)

624 .2 & 669

de Obras Públicas, nº 2723, 1 de marzo, p. 117.
DIZABAL (D.). — Laminación de **perfiles de dimensiones.** (4 000 palabras & fig.)

625 .42 (.460) & 656 .254 (.460)

de Obras Públicas, nº 2725, 1 de mayo, p. 222.
Z DEVESA (M.). — **Enclavamiento C. T. C.** en opolitano de Madrid. (1 000 palabras & fig.)

624 .63 (.460)

de Obras Publicas, nº 2725, 1 de mayo, p. 234.
ALBA GRANDA (C.). — El **puente** del Gua- ir en Brenes (Sevilla.) (2 400 palabras & fig.)

62. (01 & 721 .9

de Obras Públicas, nº 2727, 1 de julio, p. 347; 2728, 1 de agosto, p. 393; nº 2729, 1 de sep- nbre, p. 452.
QUIZ (J. L.) & ANGULO (A.). — **Cálculo de s rectangulares de hormigón armado,** sometidas a oblicua. (6 000 palabras, 1 quadro & fig.)

625 .144.2

de Obras Públicas, nº 2728, 1 de agosto, p. 385.
ITTE (C.). — **Curvas de enlace.** (3 000 palabras

1942/43 624 .63 (.460)

Revista de Obras Públicas, nº 2730, 1 de octubre, p. 500; nº 2731, 1 de noviembre, p. 531; nº 2732, 1 de deciembre, p. 579; nº 2733, 1 de enero, p. 14; nº 2734, 1 de febrero, p. 65.
CASTELLON (F.), VILLALBA (C.), SALAZAR (A.) & TORROJA (E.). — **Viaducto** Martin Gil. (16 000 palabras & fig.)

1942 656 .256 (.460)

Revista de Obras Públicas, nº 2731, 1 de noviembre, p. 549.
DE SALAS (J. N.). — « **Block** » **en via única.** (1 500 palabras & fig.)

In Italian.

L'Ingegnere. (Milano.)

1940 625 .11 (.45)

L'Ingegnere, nº 4, 15 aprile, p. 276.
COPERCHINI (D.). — Le comunicazioni ferroviari di Genova con l'Emilia e le Venezie. **Progetta di ferrovia** da Genova a Borgo Val di Taro. (2 400 parole & fig.)

1940 621 .431 .72 (.45)

L'Ingegnere, nº 5, 15 maggio, p. 425.
GERRA (F.). — Una **locomotiva Diesel** a trasmissione diretta. (1 700 parole & fig.)

1940 621 .335 (.45) & 621 .338 (.45)

L'Ingegnere, nº 6, 15 giugno, p. 445.
CARLI (C.). — Gli **elettrotreni** italiani. (3 500 parole & fig.)

1940 625 .253 (.45)

L'Ingegnere, nº 8, 15 agosto, p. 618.
FASOLI (M.). — Il **freno Breda** per treni merci. (3 000 parole & fig.)

1940 624 .2

L'Ingegnere, nº 9, 15 settembre, p. 682.
COLONNETTI (G.). — **Elasticità e resistenza di travi** con armature preventivamente tese. (1 000 parole & fig.)

Rivista tecnica delle Ferrovie italiane. (Roma.)

1940 385. (09.3 (.45)

Rivista tecnica delle ferrovie ital., 15 maggio, p. 193.
BAJOCCHI (U.). — Tre ottobre 1839. (Apertura al pubblico esercizio della **prima ferrovia italiana.**) (9 600 parole, tavole & fig.)

1940 621 .132.8 (.63)

Rivista tecnica delle ferrovie ital., 15 maggio, p. 215.
GRAZZINI. — **Locomotive Garratt** per l'Impero. (1 300 parole & fig.)

1940 625 .13 (.45)
Rivista tecnica delle ferrovie ital., 15 maggio, p. 220.

LO CIGNO (E.). — Il **cavalcavia** di S. Salvario in Stazione di Torino P. N. ed il correttivo plastico nel calcolo dei ponti a sistema cellulare. (7 000 parole & fig.)

1940 624 .63 (.45)
Rivista tecnica delle ferrovie ital., 15 giugno, p. 249.

POLSONI (G.). — Un **ponte** sul fiume Aniene per i nuovi impianti ferroviari di Roma. (2 500 parole, 4 tavole & fig.)

1940 656 .211.7 (.45)
Rivista tecnica delle ferrovie ital., 15 giugno, p. 257.

PALMERIO (D.). — Origini e sviluppi del **traghetto ferroviario** in Italia. (8 000 parole & fig.)

1940 625 .151 & 656 .222.2
Rivista tecnica delle ferrovie ital., 15 giugno, p. 283.

CORINI (F.). — **Azioni dinamiche sugli scambi deviati** (Nuovi criteri sulla valutazione della velocità massima.) (4 000 parole & fig.)

1940 625 .13
Rivista tecnica delle ferrovie ital., 15 giugno, p. 297.

MARTINI (D.). — Considerazioni sulla **manutenzione delle gallerie.** (4 500 parole & fig.)

1940 621 .332 (.45)
Rivista tecnica delle ferrovie ital., 15 luglio, p. 1.

PROSPERI (L.) & TRINCHIERI (A.). — Un notevole contributo all' autarchia. Di alcune interessanti prove eseguite dalle Ferrovie dello Stato su i più recenti **tipi di sostegni adottati per le linee elettriche primarie.** (7 000 parole, tabelle & fig.)

In Dutch.

De Ingenieur. (Den Haag.)

1940 62. (01 & 721 .9
De Ingenieur, Nr. 18, 3 Mei (bijlage), p. Bt. 37.

BOONSTRA (G. C.). — **Krimp bij betonconstructies** (Slot.) (8 000 woorden & fig.)

1940 625 .62
De Ingenieur, Nr. 23, 7 Juni, p. A. 189.

Richtingwijzers aan tramrijtuigen. (500 woorden.)

1940 625 .13 (.492)
De Ingenieur, Nr. 26, 28 Juni, p. B. 103.

van BRUGGEN (J. P.). — De **tunnelverbinding** onder het IJ te Amsterdam. (2 000 woorden & fig.)

1940 625 .13
De Ingenieur, Nr. 29, 19 Juli, p. W. 39.

VISSER (P.). — **Mechanische installaties** c. a. v Maastunnel te Rotterdam. (9 600 woorden, ta & fig.)

1940
De Ingenieur, Nr. 35, 30 Augustus, p. W. 57.

KOITER (W. T.). — Berekening van **veerend ges balken.** (2 000 woorden, 2 tabellen & fig.).

1940 721 .9
De Ingenieur, Nr. 36, 6 September, p. Bt. 61.

VAN ROOD (A. H.). — **Gewapend betonwerke** de Hoogovens. (2 300 woorden & fig.)

1940
De Ingenieur, Nr. 40, 4 October, p. Bt. 65.

MAZURE (J. P.). — Een nomogram voor rec kige **betondoorsneden** met dubbele wapening. (1 000 den & fig.)

1940 65
De Ingenieur, Nr. 42, 18 October, p. V. 51; N 29 November, p. V. 63.

DIEPHUIS (G.). — Over een ouden leidraad v **bepaling der zelfkosten bij spoor- en tram** (6 000 woorden, tabellen & fig.)

1941 625 .13
De Ingenieur, Nr. 4, 24 Januari, p. B. 7; Nr. 5, nuari, p. B. 21.

van BRUGGEN (J. P.). — De **Maastunnel** te dam. Proefnemingen en onderzoekingen. (10 000 den, 5 tabellen & fig.)

1941 62. (01 &
De Ingenieur, Nr. 8, 21 Februari, p. Mk. 7.

Structuurveranderingen bij het lasschen van la hooggelegeerde stalen. (700 woorden & fig.)

Spoor- en Tramwegen. (Utrecht.)

1940 625 .163
Spoor- en Tramwegen, Nr. 14, 6 Juli, p. 279.

Stationsversiering der Nederlandsche Spoor (1 000 woorden & fig.)

1940 385 .113
Spoor- en Tramwegen, Nr. 14, 6 Juli, p. 284.

De **Nederlandsche Spoorwegen** in 1939. (800 w & 1 tabel.)

1940 656
Spoor- en Tramwegen, Nr. 14, 6 Juli, p. 289.

TISSOT VAN PATOT (J. P. B.). — De nieuw **ling van het vervoer.** (3 000 woorden.)

1940 656 .211
Spoor- en Tramwegen, Nr. 15, 20 Juli, p. 301.

VAN SETTEN (D.). — De **stations en spoorv sluitingen** te Rotterdam. (2 000 woorden & fig.)

40 **625 .2 (.45)**
- en Tramwegen, Nr. 16, 3 Augustus, p. 319.
uw rollend materieel der Italiaansche Staatspoor-
ı. (1 000 woorden & fig.)

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40 **621 .431 .72 (.492)**
- en Tramwegen, Nr. 17, 17 Augustus, p. 335;
Ir. 18, 31 Augustus, p. 354; Nr. 19, 14 September,
. 375.
nieuwe Diesel-Electrische Vijfwagentreinen der
(7 000 woorden & fig.)

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40 **385. (09 (.498)**
- en Tramwegen, Nr. 17, 17 Augustus, p. 341.
N SETTEN (D.). — Roemeensche **verkeersvraag-
en.** (2 300 woorden, 1 tabel & fig.)

1940 **656 .257 (.492)**
Spoor- en Tramwegen, Nr. 18, 14 September, p. 373.
DE WIT (J.). — Invoering van een nieuwe **draadrol voor trekdraadgeleidingen** bij de N. S. (1 500 woorden & fig.)

1940 **621 .131.1 & 621 .431 .72**
Spoor- en Tramwegen, Nr. 20, 28 September, p. 396.
LABRIJN (P.). — De **aangetrekkracht** van stoom- en Diesel-electrische rangeerlocomotiven. (1 500 woorden, 4 tabellen & fig.)

1940 **656 .261**
Spoor- en Tramwegen, Nr. 20, 28 September, p. 403.
HELLINGS (J. B.). — Het vervoer van steenkolen in open **spoorweglaadkisten.** (1 200 woorden & fig.)

M. Weissenbruch Co., Ltd., Printer of the King, 49, rue du Poinçon, Bruxelles.